SOIL SURVEY OF

Gove County, Kansas

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Kansas Agricultural Experiment Station

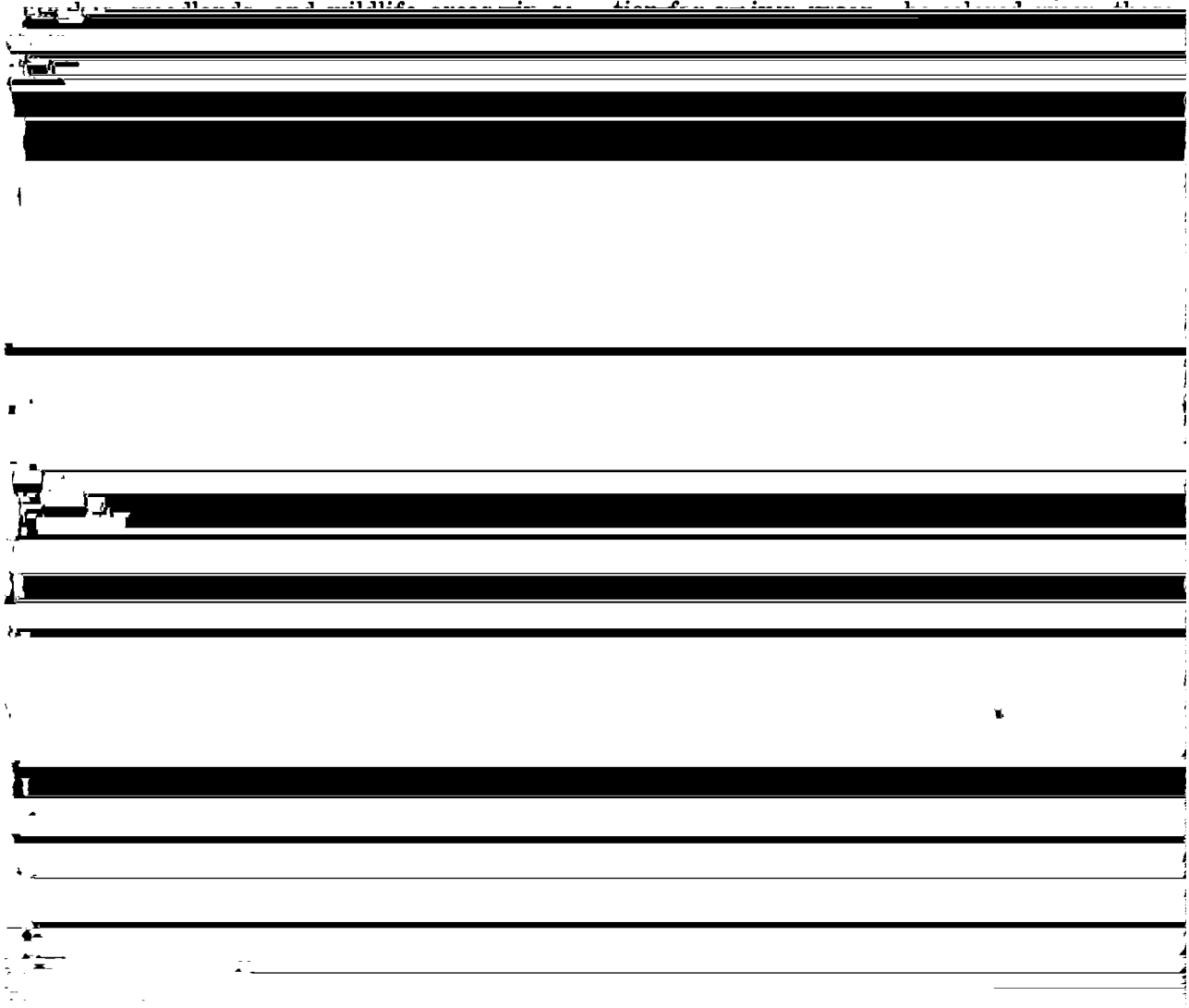
This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1958–73. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1974. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Gove County Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, [redacted] soils that have the same limitation or suitability. For example, soils that have a slight limita-



lecting sites for roads, ponds, buildings, and other structures; and in judging the suitability with a moderate limitation can be colored yellow, and those with a severe limitation can be

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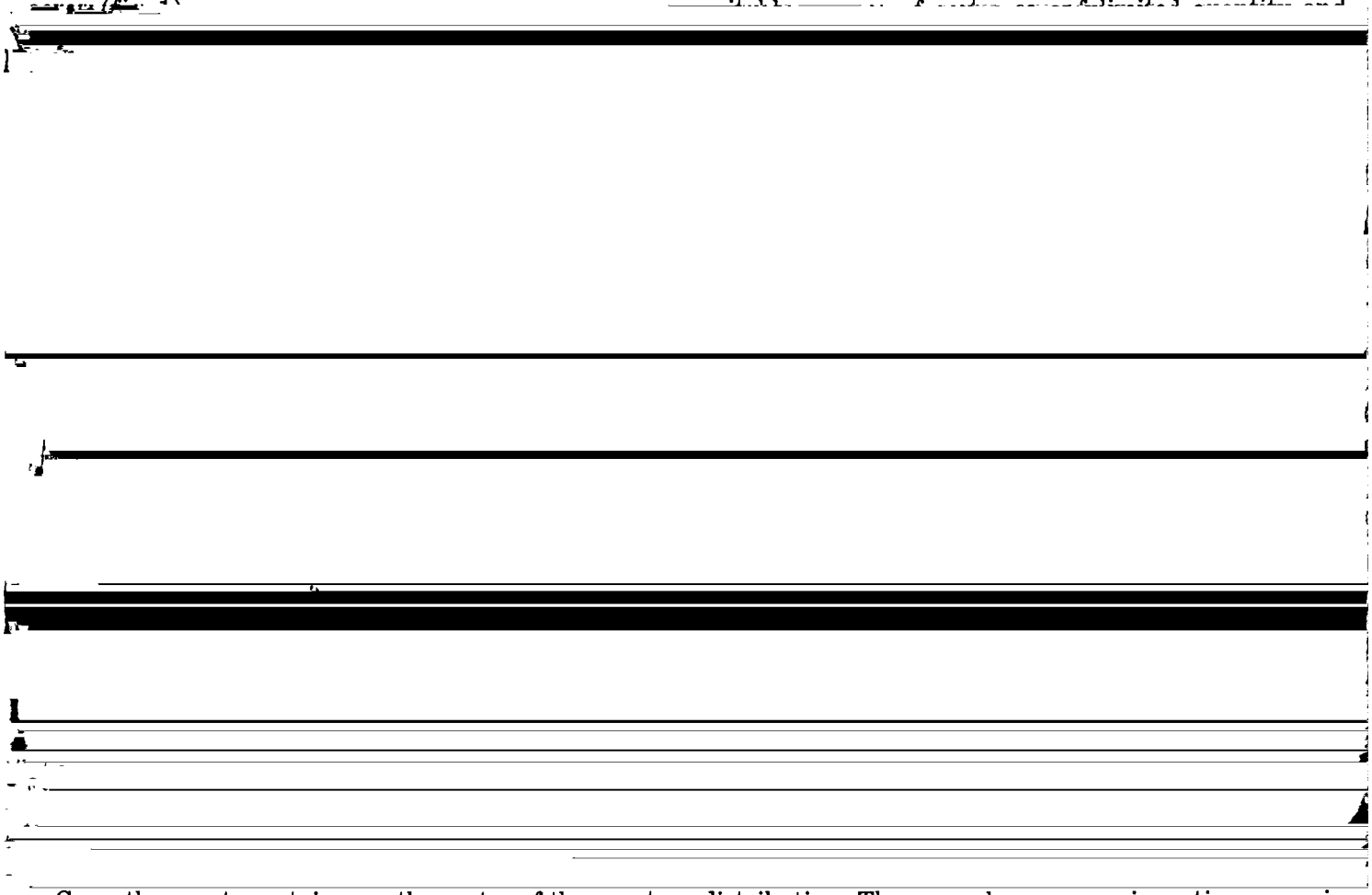
SOIL SURVEY OF GOVE COUNTY, KANSAS

By Raymond C. Angell, Clarence M. Call, and Lyle D. Linnell, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in Cooperation with the Kansas Agricultural Experiment Station

GOVE COUNTY is in the west-central part of Kansas. It covers 1,070 square miles, or 684,800 [illegible] are also important crops but are mainly used for livestock feed. Irrigation is increasing in the county, but [illegible]



Gove, the county seat, is near the center of the county along Hackberry Creek. The county population is about 4,000.

This county has a continental semiarid climate. It is in the High Plains section of the Great Plains physiographic province. The elevation ranges from 3,000 feet in the northwestern part of the county to 2,300 feet in the Smoky Hill Valley at the eastern county line.

The northern part of the county is characterized by nearly level to gently sloping tableland where deep soils formed in a thick deposit of silty loess. It is dissected by relatively narrow drainageways. In the southern part of the county, the Smoky Hill River and distribution. There are large areas in native grass in the vicinity of the Smoky Hill River and smaller areas along the drainageways in other parts of the county. About half of the land area is used for native grass and half for cultivated crops.

How This Survey Was Made

Soil scientists made this survey to learn what kind of soils are in Gove County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had

loam, 1 to 3 percent slopes, is one of several phases within the Elkader series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show range, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this survey was prepared from aerial photographs.

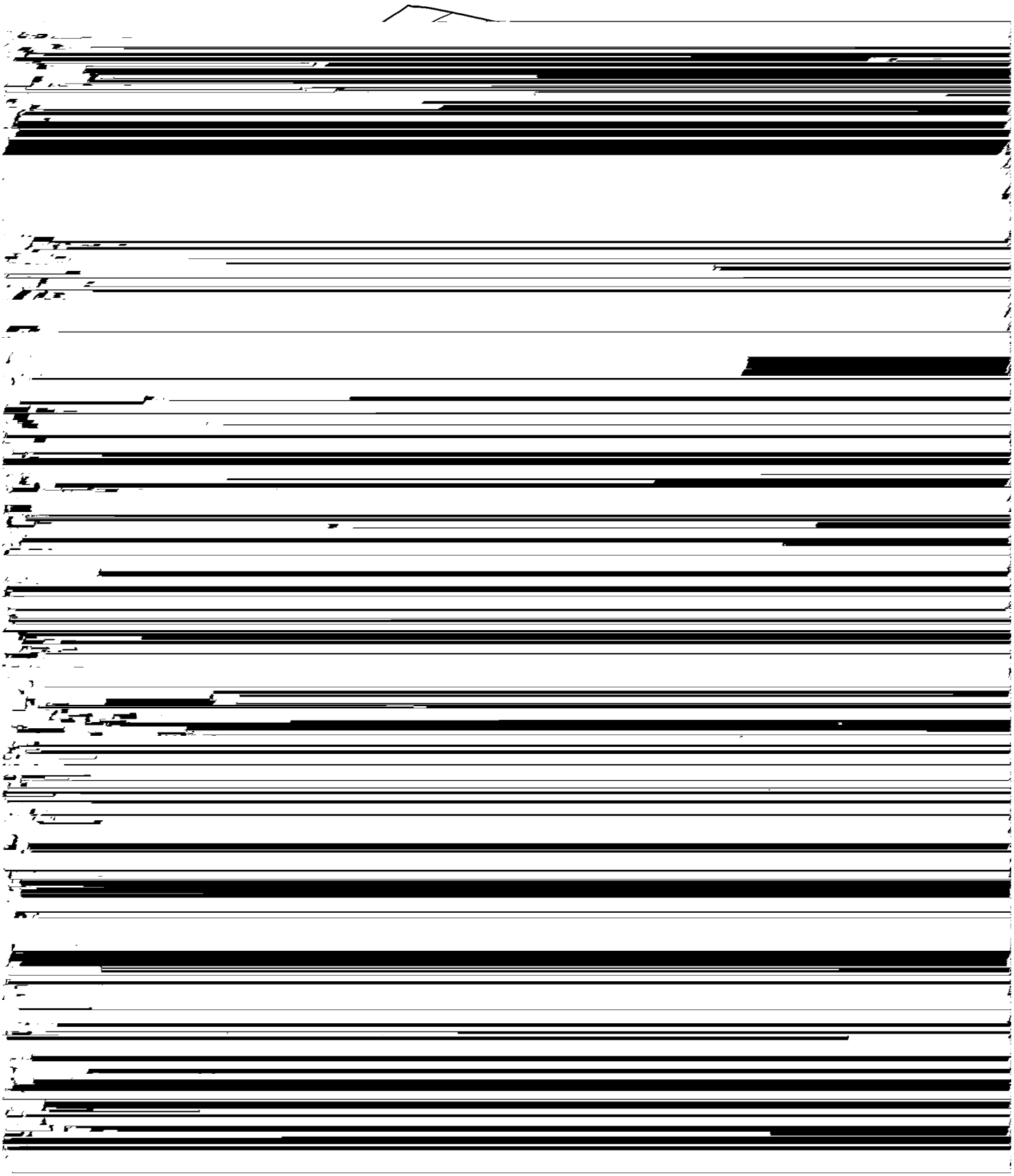
The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different

farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in an association can occur in other associations, but in different patterns.



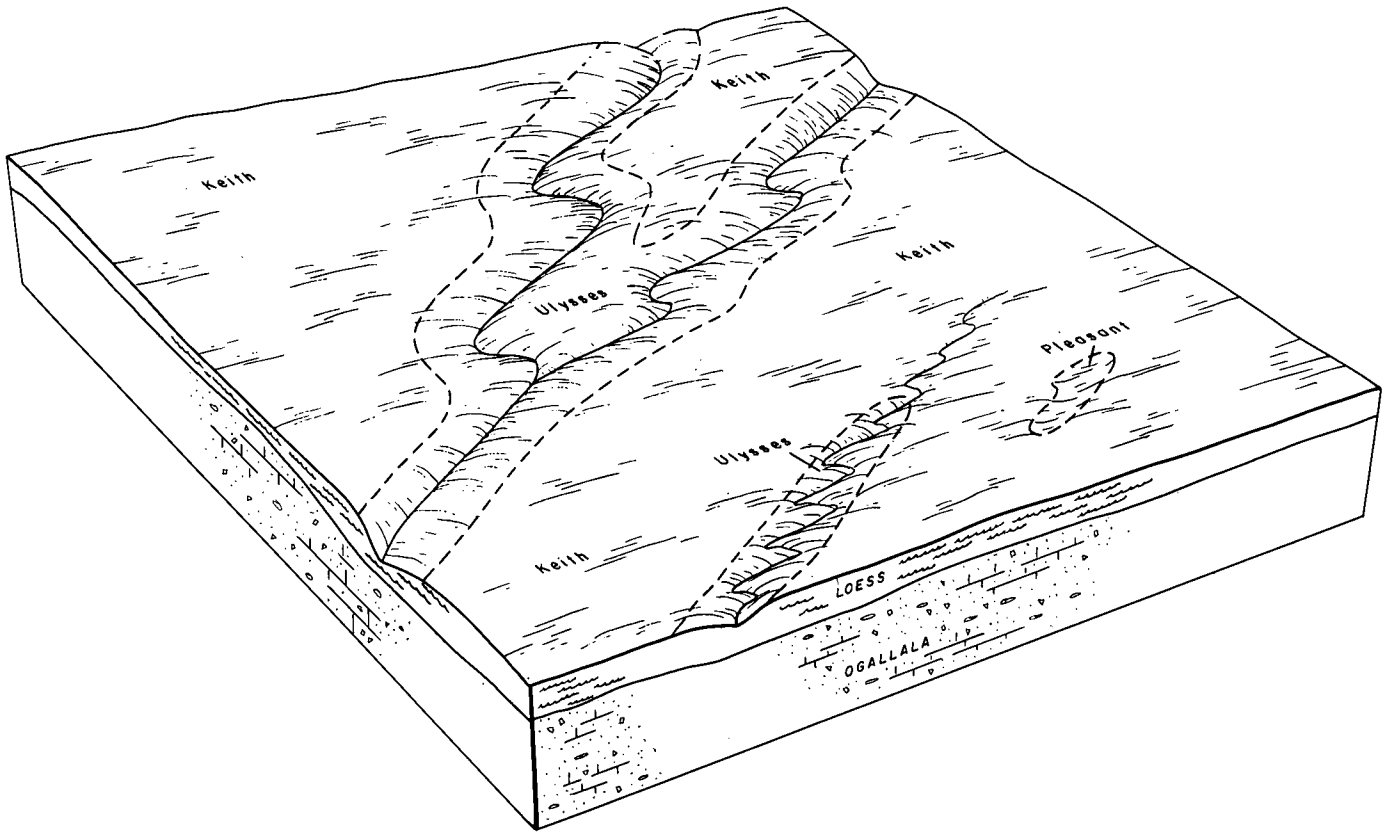
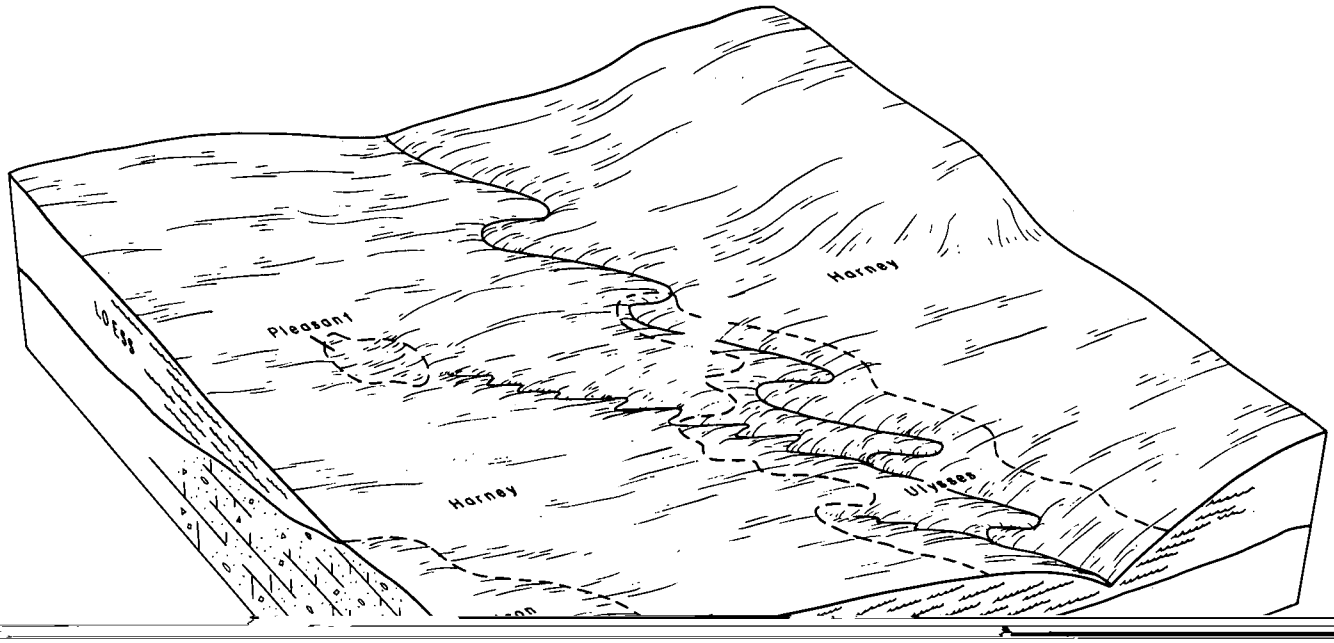
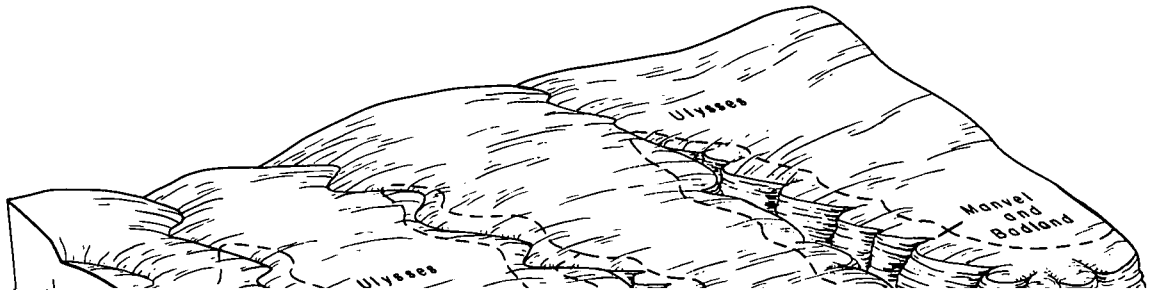


Figure 3.—A typical pattern of soils in the Keith-Ulysses association.


Loess
Pleasant
Harney
Harney
Ulysses


Ulysses
Manvel and Badland
Ulysses

maintaining fertility. Some of the cultivated areas on bottom lands need protection from flooding.

Most of this association is in native grass. A few areas of the soils that have favorable slopes on that

describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for dry soil unless otherwise stated.

As mentioned in the section "How This Survey Was

bols that have been used on the map are discussed in the following paragraphs.

Small areas of gravelly soils are shown within areas of nongravelly soils by the gravel symbol. Each symbol represents an area of less than 5 acres in size. These

narrow strip around the edge that has slopes of 30 percent or more. The soil now consists of deep loess or old outwash materials ranging from silt loam to clay loam. In most places these areas have strong effervescence or violent effervescence and are moderately alka-

The A1 horizon is 3 to 10 inches thick. It ranges from gray to pale brown. It is loam, silt loam, or silty clay loam; silt loam is dominant. The AC horizon is 5 to 25 inches thick. It ranges from grayish brown to pale yellow and from loam to silty clay loam; it is silt loam in most pedons. The Cca horizon is 10 to 20 inches thick. It ranges from light brownish gray to very pale brown and from loam to silty clay loam; it is dominantly silt loam. The C horizon ranges from light brownish gray to very pale brown and extends to a depth of about 60 inches. It is loam, silt loam, or silty clay loam.

These soils are weakly stratified in texture and color. In

irrigated, this soil is also suited to a tame grass mixture grown for hay or pasture. Soil blowing and occasional flooding are the main hazards. Some areas need protection from the runoff water from adjacent uplands. Iron chlorosis of sorghums is also a problem because the soil has a high lime content. The main concerns of management are controlling soil blowing and conserving moisture. Effective management practices are stubble mulching and wind stripcropping. Range needs protection from overgrazing.

[redacted]

brown (10YR 4/3) when moist; moderate medium subangular blocky structure; slightly hard when dry, friable when moist; few fine roots; strong

ments of caliche as large as 3/4 inch; strong effervescence; moderately alkaline; gradual smooth boundary.

part of the B2t horizon ranges from dark grayish brown to pale brown. The B2t horizon is silty clay loam, heavy clay loam, or silty clay. The C horizon is pale brown to white to a depth of 60 inches. It is loam, clay loam, or silty clay loam, but nonconforming sandier layers are below a depth of 40 inches in some pedons. Depth to calcareous material is 12 to 18 inches and to the Cca horizon that contains 20 to 40 percent carbonates, by volume, is 30 inches or less.

Carlson soils are associated with Campus and Harney soils. They have a thicker profile and a more clayey subsoil than Campus soils. They have unconsolidated caliche beds or highly calcareous alluvial deposits that contain many large concretions in the lower horizons which Harney soils lack.

Cd—Carlson-Campus complex, 1 to 3 percent slopes. This mapping unit is gently sloping and is on convex ridgetops. It is about 55 percent Carlson silt loam and 45 percent Campus silty clay loam. The Campus soils are on small knolls that have Carlson soils surrounding them.

Included in mapping are a few small areas of Harney and Penden soils in areas that are deeper to the highly calcareous material. Also included are a few small areas of soils that have a gravelly surface layer. Areas of caliche outcrops are included and identified on the soil map by the appropriate symbol.

dry, friable when moist; few roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

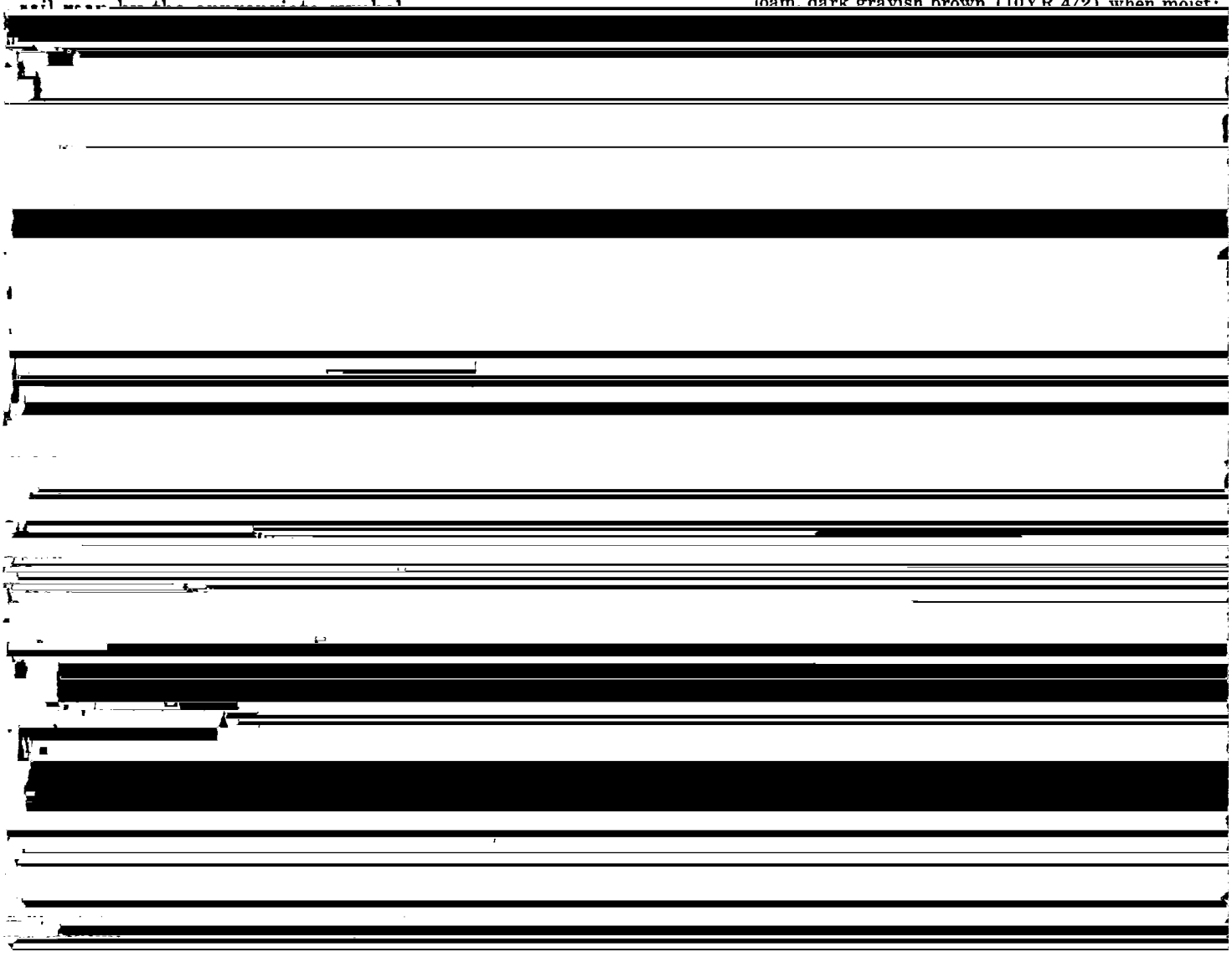
A12—6 to 11 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate fine granular structure; slightly hard when dry, friable when moist; few worm casts; few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

A13—11 to 19 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate medium subangular blocky structure; slightly hard when dry, friable when moist; many worm casts; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—19 to 29 inches; gray (10YR 6/1) silt loam, dark grayish brown (10YR 4/2) when moist; moderate fine subangular blocky structure; slightly hard when dry, friable when moist; many worm casts; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—29 to 41 inches; gray (10YR 6/1) loam, dark grayish brown (10YR 4/2) when moist; moderate fine subangular blocky structure; slightly hard when dry, friable when moist; few faint brown mottles; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C3—41 to 48 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist;



tility and uses water efficiently. Using good quality water is particularly important because of the water table. Salinity may be increased by applications of poor quality water, and sufficient leaching may be difficult or impossible to accomplish. Also, the water table may be raised by the application of too much water. Among effective management practices are crop residue use, fertilization, and a conservation cropping system. Land leveling is generally needed for surface irrigation. Lined ditches or surface or underground pipes are needed for more efficient use of water. Either surface or sprinkler irrigation systems are satisfactory. Capability units IIIw–1 dryland and IIIw–1 irrigated; Saline Subirrigated range site.

Dix Series

The Dix series consists of excessively drained soils that are shallow to sand and gravel. These soils formed on uplands in coarse textured old outwash and terrace deposits. Slopes range from 6 to 40 percent.

In a representative profile the surface layer is grayish brown gravelly sandy loam about 6 inches thick. The layer below that is grayish brown, very friable gravelly loamy sand about 5 inches thick. The underlying material is stratified light brownish gray and pale brown gravelly loamy sand and mixed sand and gravel; it extends to a depth of about 60 inches.

The available water capacity is low, and permeability is rapid. Runoff is medium. Fertility is low.

These soils are not suited to cultivated crops. They are used for native grass.

Representative profile of Dix gravelly sandy loam, in an area of Dix soils, 6 to 40 percent slopes, in native

loam to gravelly loamy sand; gravelly sandy loam is most common.

Included in mapping are small areas of Canlon, Kim, Penden, Otero, and Ulysses soils. Gravel pits are included and identified on the soil map by appropriate symbols.

This mapping unit is used for native grass. The unfavorable slopes, fertility, and low available water capacity make cultivation impractical. The native vegetation is mixed mid grasses, tall grasses, and short grasses with many annuals and some small soapweed. These soils are unstable and need protection from overgrazing. Capability unit VIIs–1 dryland; Gravelly Hills range site.

Elkader Series

The Elkader series consists of deep, well drained soils on uplands. These soils formed in silty materials weathered from soft limestone or chalky shale modified by varying amounts of silty eolian materials. Slopes range from 1 to 15 percent. The native vegetation was mainly mid grasses and short grasses with a high proportion of sideoats grama.

In a representative profile the surface layer is grayish brown silt loam about 9 inches thick. The subsoil is light brownish gray, friable silt loam about 11 inches thick. The underlying material is very pale brown silt loam to a depth of about 60 inches.

The available water capacity is high, and permeability is moderate. Runoff is slow to rapid depending on slope. Fertility is medium.

These soils are used for native grass and for culti-

Elkader soils contain more lime than the associated Ulysses soils. They have a thicker, dark surface layer and contain less lime than the associated Manvel soils. They are deeper over chalky shale than the associated Badland.

Eb—Elkader silt loam, 1 to 3 percent slopes. This soil is gently sloping and is in broad areas below the table land. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Ulysses and Manvel soils. The Ulysses soils border the table land and the Manvel soils are in areas of broken slopes.

This soil is suited to irrigation. If irrigated it is

are composed of Elkader silt loam, Manvel silt loam, or a mixture of the two. The total acreage is about 45 percent Elkader soil and 35 percent Manvel soil. The Elkader soil is in the less sloping areas, and the Manvel soil is in the more sloping, broken areas.

Included in mapping are small areas of less sloping Ulysses soils. Rock outcrops, gravel pits, and severely eroded spots are included and are identified on the soil map by appropriate symbols.

This mapping unit is not well suited to cultivated crops because there is a severe hazard of erosion. It is used mainly for native grass. A few small areas are cultivated along with fields of less strongly sloping

moist; strong effervescence; moderately alkaline; common films and soft masses of calcium carbonate.

The Ap and A1 horizons combined are 6 to 15 inches thick. They range from dark grayish brown to brown and are silt loam or light silty clay loam. The A horizon is slightly acid or neutral. The B1 horizon is 3 to 6 inches thick and ranges from dark grayish brown to brown. The Bt horizon is 8 to 16 inches thick and is silty clay loam or silty clay. The upper part of the Bt horizon ranges from dark grayish brown to brown and the lower part from dark grayish brown to pale brown. The B3 horizon is 4 to 8 inches thick and is light brownish gray to very pale brown. In most places the lower part of the B horizon contains free carbonates, generally in visible form. The B horizon is neutral to moderately alkaline. Depth to calcareous material ranges from 18 to 30 inches.

The Harney soils are associated with Carlson and Pleasant soils and are in positions similar to those of the Keith soils. They lack the substratum of unconsolidated caliche or the many large lime concretions that are characteristic of Carlson soils. They have a more clayey Bt horizon than Keith soils and a less clayey Bt horizon than Pleasant soils.

Ha—Harney silt loam, 0 to 1 percent slopes. This soil is nearly level and is on broad ridgetops. It has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Keith soils at a slightly higher elevation and Pleasant soils in small depressions. The small depressions are identified on the soil map by appropriate symbols.

If irrigated, this soil is suited to sorghums, corn, wheat, alfalfa, sugar beets, and tame grasses grown for hay or pasture. It is used mainly for cultivated crops. A few areas are in native grass, and some areas are irrigated. Wheat and sorghums are the main dryland crops. When this soil is not protected by vegetative cover, soil blowing is a hazard. The main concerns

Figure 7.—Stubble mulch on Harney silt loam. The stubble helps

Inavale Series

The Inavale series consists of deep, somewhat excessively drained soils on flood plains along the Smoky Hill River and some of the larger tributary streams. The topography of uneven microrelief was caused by old meandering stream channels. These soils formed in stratified, calcareous sandy alluvium that contains some gravel. Slopes are mainly less than 1 percent.

In a representative profile the surface layer is light brownish gray loamy sand about 7 inches thick. The layer below that is light gray loamy sand about 11 inches thick. The underlying material is light gray loamy coarse sand to a depth of 60 inches.

The available water capacity is low, and permeability is rapid. Runoff is slow. These soils are frequently [redacted]

This mapping unit is not suited to cultivated crops. It is used mainly for native grass. It produces only sparse stands of short grasses, annuals, and sagebrush. In some places there are a few cottonwoods and willows. Frequent flooding and the resultant scouring and deposition and the low available water capacity are the main limitations. These soils are unstable and need protection from overgrazing. Capability unit VIe–2 dryland; Sandy Lowland range site.

Keith Series

The Keith series consists of deep, well drained soils on uplands. These soils formed in calcareous silty loess. Slopes range from 0 to 3 percent.

In a representative profile (fig. 8) the surface layer

[redacted]

cent slopes, in a cultivated field, 1,200 feet south, 2,615 feet east of the northwest corner of sec. 18, T. 12 S., R. 30 W.

A1—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak very fine granular structure; slightly hard when dry, friable when moist; many fine roots; few worm casts; neutral; clear smooth boundary.

B1—7 to 12 inches; dark grayish brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; moderate fine subangular blocky structure; slightly hard when dry, friable when moist; many fine roots; few worm casts; mildly alkaline; gradual smooth boundary.

B21t—12 to 17 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate fine subangular blocky structure; slightly hard when dry, friable when moist; few fine roots; mildly alkaline; gradual smooth boundary.

B22t—17 to 22 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate fine and very fine subangular blocky structure; slightly hard when dry, friable when moist; few fine roots; mildly alkaline; clear smooth boundary.

C1ca—22 to 38 inches; very pale brown (10YR 8/3) silt loam, pale brown (10YR 6/3) when moist; massive; slightly hard when dry, friable when moist; few fine roots; strong effervescence; thin discon-

tour farming. Terraces control runoff and conserve moisture. Controlled grazing prevents overuse of areas in native grass.

Good management of irrigated areas maintains soil fertility and uses water efficiently. Among the effective practices are crop residue use, fertilization, and use of a conservation cropping system. Most areas need land leveling for efficient surface irrigation. Lined ditches or surface or underground pipe are needed for more efficient use of water. Either surface or sprinkler irrigation systems can be used. Capability units IIc–1 dryland and I–1 irrigated; Loamy Upland range site.

Kb—Keith silt loam, 1 to 3 percent slopes. This soil is gently sloping and is on slightly concave side slopes. It has a profile similar to the one described as representative of the Keith series, but depth to free carbonates ranges from 15 to 22 inches. Included in mapping are a few small areas of Ulysses soils along small drainageways.

If irrigated, this soil is suited to sorghums, corn, wheat, alfalfa, and tame grasses grown for hay or pasture. It is used mainly for cultivated crops. A few areas are in native grass, and some areas are irrigated. Wheat and sorghums are the main dryland crops. Soil blowing and water erosion are hazards. The main concerns of management are conserving moisture and con-

A1—0 to 5 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; moderate fine and very fine granular structure; slightly hard when dry, friable when moist; many fine and very fine roots; few worm casts; few

layer is very pale brown, friable silt loam about 20 inches thick. The underlying material is very pale brown silt loam to a depth of 60 inches.

The available water capacity is high, and permea-

described as representative of the series, but the surface layer is thinner.

Included in mapping are a few small areas of Canlon, Dix, Elkader, Penden, and Ulysses soils. Also included are small areas of soils that are similar to Manvel soil but are less than 40 inches deep over chalky shale or soft limestone. About 700 acres [illegible]

effervescence; moderately alkaline; abrupt smooth boundary.

IIC3—36 to 60 inches; sand that has a few coarse fragments; slight effervescence; mildly alkaline.

The Ap and A12 horizons combined are 9 to 15 inches thick and range from grayish brown to pale brown. The A horizon is light loam to sandy loam. The C horizon is 20 to [illegible]

Otero Series

The Otero series consists of deep, well drained soils on uplands. These soils formed in calcareous, loamy eolian and outwash material. Slopes are mainly between 1 and 3 percent but range to about 6 percent.

In a representative profile the surface layer is light brownish gray heavy fine sandy loam about 6 inches thick. The layer below that is very pale brown, friable heavy sandy loam about 12 inches thick. The underlying material to a depth of 60 inches is stratified. The upper 12 inches is very pale brown sandy loam, the middle 14 inches is very pale brown loamy sand, and the lower 16 inches is very pale brown heavy sandy loam.

Rock outcrops are included and identified on the soil map by an appropriate symbol. Each symbol represents an area of less than 3 acres.

This soil is suited to irrigation. If irrigated, it is suited to sorghums, corn, wheat, alfalfa, and tame grasses grown for hay or pasture. It is used for native grass and for cultivated crops. Sorghums and wheat are the main dryland crops. When this soil is not protected by vegetative cover, soil blowing is a severe hazard. Water erosion is also a hazard. The main concerns of management are conserving moisture and controlling water erosion and soil blowing. Effective management practices are stubble mulching, terracing, contour farming, and stripcropping. Grazing needs to be controlled on native grass to prevent over-

meability is rapid. Runoff is medium. Fertility is medium.

Good management of irrigated areas controls erosion and soil blowing, maintains fertility, and uses

hard when dry, friable when moist; common films and soft masses of lime; violent effervescence; moderately alkaline.

The A1 horizon is 7 to 20 inches thick. It ranges from dark grayish brown to brown and is clay loam or silty clay loam. It ranges from mildly alkaline to moderately alkaline. The B2ca horizon is 12 to 20 inches thick. It is light brownish gray to very pale brown. The C horizon ranges from light brownish gray to pale yellow.

Penden soils contain more sand than Ulysses soils that have similar topography. They have a thicker dark surface layer than Campus and Kim soils that developed in similar parent material.

Pe—Penden clay loam, 3 to 6 percent slopes. This soil is gently sloping and is on the sides of upland drainageways.

Included with this soil in mapping are small areas of steeper Campus and Canlon soils underlain by caliche and areas of Elkader, eroded Penden, and Ulysses soils. Rock outcrops, gravel spots, severely eroded spots, and gumbo or scabby spots are included and identified on the soil map by appropriate symbols.

This soil is used for native grass and for cultivated crops. Wheat and sorghums are the main dryland crops. When this soil is not protected by vegetative cover, water erosion and soil blowing are hazards. The main concern of management are conserving

The A1 horizon is 4 to 8 inches thick and ranges from dark gray to brown. The B1 horizon is 4 to 8 inches thick and ranges from dark gray to brown. The B2t horizon is 10

Representative profile of Roxbury silt loam, in native grass, 2,110 feet north, 1,720 feet east of the south-

Figure 10.—**Alfalfa growing in an area of Roxbury soil. The Campus-Canlon complex is in the foreground.**

tains fertility and uses water efficiently. Among effective management practices are crop residue use, fertilization, and use of a conservation cropping system. Land leveling is generally needed for surface irrigation. Lined ditches or surface or underground pipes are needed for more efficient use of water. Either surface or sprinkler irrigation can be used. Some areas need protection from the runoff water from adjacent uplands. Capability units IIc–2 dryland and I–2 irrigated; Loamy Terrace range site.

Rb—Roxbury soils, frequently flooded. This soil is nearly level and is on flood plains. It has a profile similar to the one described as representative of the

main hazard. The main concerns of management are conserving moisture and preventing flooding. Effective management practices are stubble mulching and the use of levees for flood protection. Wheat is seldom grown on this soil because flooding often occurs when it is ready for harvest. Controlled grazing prevents overuse of native grass areas.

If irrigated this soil is suited to sorghums, corn, alfalfa, and tame grasses grown for hay or pasture. Good management of irrigated areas maintains fertility, controls flooding, and uses water efficiently. Among effective management practices are the use of crop residue, dikes, windrows for flood protection, fertiliza-

described as representative of the series, but the surface layer ranges from loam to silty clay loam; 20 percent is a soil that is similar to Roxbury silt loam but is more stratified; and 70 percent is mixed, calcareous, loamy alluvium on side slopes. This mapping unit is associated with Roxbury silt loam and Bridgeport silt loam along channels, but it is more variable and has stronger slopes than those soils. Slopes are 0 to 50 percent.

This mapping unit is not suited to cultivated crops. It is used for native grass and for wildlife habitat. The vegetation is mainly native grass, but in some places it is a dense growth of trees—mainly cottonwood, willow, and hackberry. Frequent flooding and the resultant scouring and deposition are the main hazards. These soils are unstable and need protection from overgrazing. Capability unit VIw–1 dryland; Loamy Lowland range site.

Ulysses Series

layer is dark grayish brown silt loam 10 inches thick. The subsoil is light brownish gray, friable silt loam 5 inches thick. The underlying material is very pale brown silt loam to a depth of 60 inches.

The available water capacity is high, and permeability is moderate. Runoff is slow to rapid. Fertility is high.

Ulysses soils are used for cultivated crops and for native grass. Wheat and sorghums are the main crops.

Representative profile of Ulysses silt loam, 1 to 3 percent slopes, in a cultivated field, 180 feet east, 1,850 feet south of the northwest corner of sec. 25, R. 12 W., T. 29 S.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak very fine granular structure; slightly hard when dry, friable when moist; many fine roots; neutral; abrupt smooth boundary.

A12—4 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate very fine and fine granular structure; slightly hard when dry, friable when moist;

irrigation. Good management of irrigated areas con- soil is sloping and is on the sides of drainageways. It

land uses may be identified, and costly failures in homes and other structures, because of unfavorable soil properties, may be avoided. A site can be selected where the soil properties are favorable, or practices can be planned that will overcome the soil limitations.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall

cropland involves a combination of practices that reduce water erosion and soil blowing, maintain good soil structure, maintain an adequate organic matter content, and conserve as much moisture as possible. Erosion control and water conservation are most successful if a proper combination of practices is used.

Terracing and contour farming can be used to reduce

Stripcropping is another measure that can be used to control soil blowing. Stripcropping is generally

tant to know the quality of the irrigation water so that the long-range effect of irrigation on the soil may be

Sorghums, corn, and wheat are the main crops grown under irrigation in Gove County. Alfalfa is grown in a few fields. Sugar beets, truck crops, and various other crops would be suitable under more intensive management.

More specific information on the management of individual soils for irrigated cropland is given in the section "Descriptions of the Soils."

Capability Grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farm. These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming.

The grouping is based on permanent limitations of soils when used for field crops, the risk of damage when they are farmed, and the way the soils respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when pasture plants, they require about the same management, and they have generally similar productivity and other response to management. Capability units are generally identified by numbers assigned locally, for example, IIe–1 or IIIw–2.

The eight classes in the capability system and the subclasses and units in Gove County are described in the list that follows. The unit designation is given in the Guide to Mapping Units.

Class I soils have few limitations that restrict their use.

Unit I–1 (irrigated).—Deep, nearly level, well drained silt loams, on uplands.

Unit I–2 (irrigated).—Deep, nearly level, well drained silt loams on terraces and high flood plains.

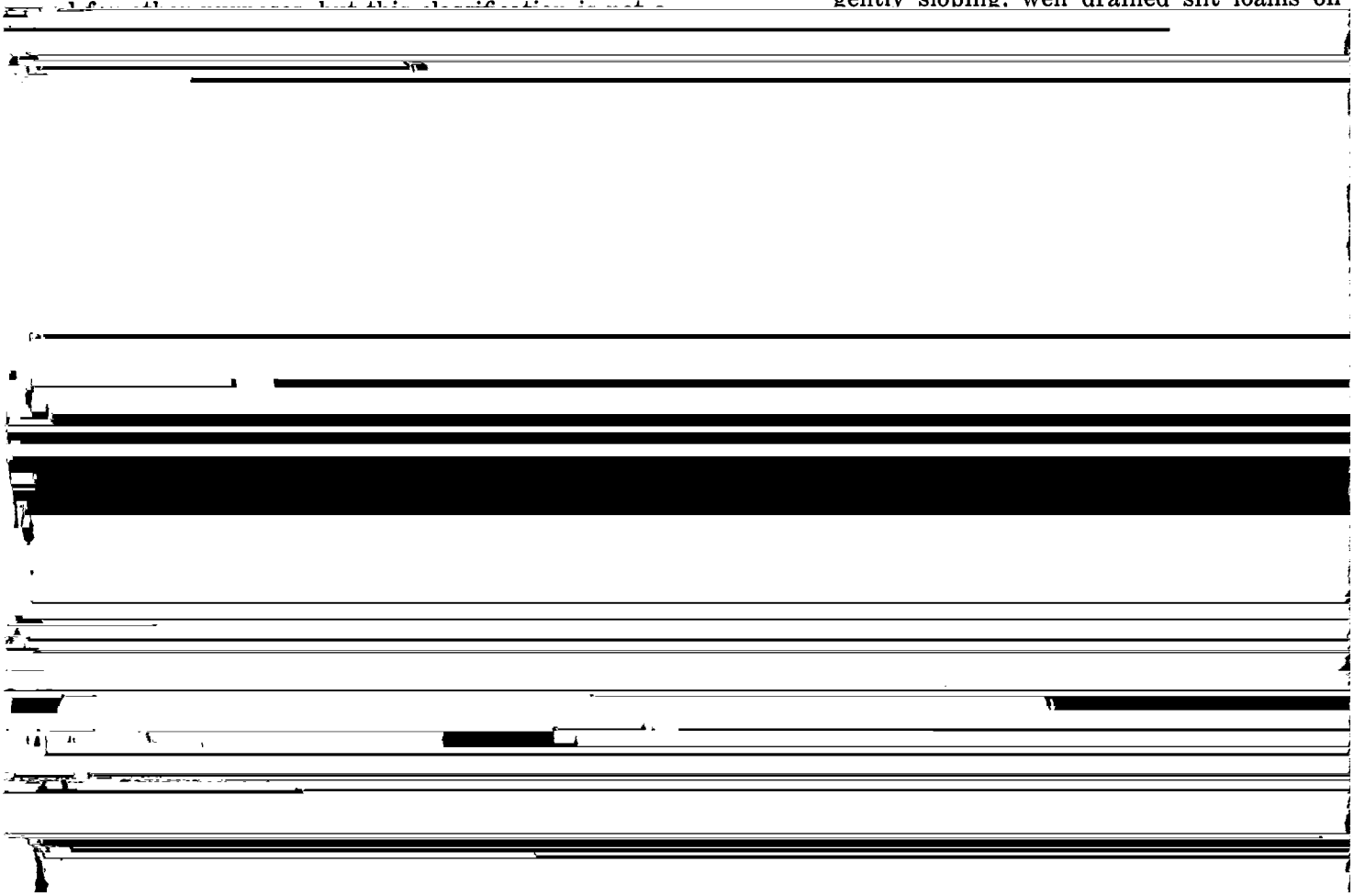
Unit I–3 (irrigated).—Deep, nearly level, well drained silt loams that have silty clay loam or silty clay subsoils, on uplands.

Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIe soils are subject to moderate erosion unless protected.

Unit IIe–1 (dryland).—Deep, nearly level to gently sloping, well drained silt loams that have silt loam to silty clay subsoils, on uplands.

Unit IIe–1 (irrigated).—Deep, nearly level to gently sloping, well drained silt loams on



Unit IIIw–1 (dryland and irrigated).—Deep, nearly level, moderately well drained to somewhat poorly drained loams on flood plains.

Unit IIIw–2 (dryland).—Deep, nearly level, well drained sandy loams and silt loams on terraces or high flood plains.

Unit IIIw–2 (irrigated).—Deep, nearly level, well drained, strongly calcareous silt loams on flood plains and low terraces.

Unit IIIw–3 (dryland).—Deep, nearly level, well drained silt loams on flood plains.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Subclass IVe soils are subject to very severe erosion if they are not protected.

Unit IVe–1 (dryland).—Deep, gently sloping, well drained silt loams on uplands.

Unit IVe–2 (dryland).—Deep, nearly level to gently sloping, well drained sandy loams on uplands.

Subclass IVw soils have very severe limitations because of excess water.

Unit IVw–1 (dryland).—Deep, nearly level, well drained and somewhat excessively drained sandy loams and loamy sands on flood plains.

Unit IVw–1 (irrigated).—Deep, nearly level, ponded silty clay loams in depressions.

Unit IVw–2 (dryland).—Deep, nearly level, ponded silty clay loams in depressions

Subclass VIIs soils have very severe limitations because of low available water capacity and steep, broken topography.

Unit VIIs–1 (dryland).—Shallow, sloping to steep, excessively drained gravelly sandy loams on knobs and broken side slopes of drainageways.

Class VIII soils and land forms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes. None in county.

Yields Per Acre

The per acre average yields that can be expected of the principal crops under a high level of management are shown in table 2. In any given year, yields may be higher or lower than those indicated because of seasonal variations in rainfall and other climatic factors. Absence of a yield estimate indicates that the crop is not suited to or not commonly grown on the soil or that irrigation of a given crop is not commonly practiced on the soil.

The predicted yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The latest soil and crop management practices used by many farmers in the county are assumed in predicting the yields. Hay and pasture yields are predicted

TABLE 2.—*Yields per acre of crops*

[Yields in columns N are for nonirrigated soils; those in columns I are for irrigated soils. All yields were estimated for a high level of management in 1974. Dashes indicate that the crop is seldom grown or is not suited. Only soils suitable for crops are listed]

Soil series and map symbols	Winter wheat		Corn		Grain sorghum		Sorghum silage	
	N	I	N	I	N	I	N	I
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Ton*	*Ton*
Angelus: An	20	40	---	100	27	80	---	15
Bridgeport: Br	26	50	---	130	42	120	---	24
Carlson: Cd	22	---	---	---	35	---	---	---
Caruso: Cr	20	40	---	110	30	90	---	20
Elkader:								
Eb	19	40	---	100	30	90	---	16
Ec	16	---	---	---	28	---	---	---
Harney:								
Ha	32	45	---	120	49	120	---	22
Hb	30	36	---	110	45	110	---	20
Keith:								
Ka	33	50	---	120	45	115	---	25
Kb	31	45	---	110	42	105	---	22
Munjor:								
Mc	25	45	---	105	40	100	---	20
Md	20	40	---	95	35	85	---	18
Otero: Ot	20	38	---	115	26	110	---	19
Penden: Pe	19	---	---	---	28	---	---	---
Pleasant: Pt	22	---	---	---	30	---	---	---
Roxbury:								
Ra	32	50	---	120	57	115	---	24
Rb	22	35	---	110	45	100	---	22
Ulysses:								
Ua	23	50	---	120	38	115	---	24
Ub	21	45	---	100	36	95	---	21
Uc	19	---	---	---	34	---	---	---
Ue	16	---	---	---	30	---	---	---

tion about the management and productivity of the soils for these crops.

Range [2]

Native grass makes up about 46 percent, or 307,000 acres, of the land area in Gove County. Small tracts occur throughout cropland of the county; larger areas are along the Smoky Hill River and its larger tributaries.

Livestock operations are of the cow-calf and grazing stocker and feeder calf types. A large number of the ranches have some cropland that is used for supplemental grazing. Most of the forage production is used to feed livestock. Much of the success or failure of any particular operation can be related to the use of the range and forage.

Most of the native vegetation on the range sites in Gove County is a mixture of short grasses and mid grasses, and some tall grasses are on favored sites. Current forage production depends on the range condition and the amount of moisture available to plants during the growing season. It is also affected by topography. Generally speaking, the range sites on hilly

[2] By LOREN J. PEARSON, range conservationist, Soil Conservation Service.

topography (fig. 14) are in better condition than those on level to gently sloping topography.

Proper use and management of range is necessary to achieve the full productive potential of a range site. These natural grasslands respond favorably when conservation and management practices based on sound ecological principles are applied.

Range sites and range condition

There are many differences in the soils and climate of Gove County. For these reasons, there are several different kinds of range. These different kinds of range are called range sites.

Over the centuries, each range site has developed a mixture of plants best suited to it. This group of plants is called the potential, or climax, plant community for the site. The climax plant community for a site varies slightly from year to year, but the kinds and amounts of plants remain about the same if the site is undisturbed.

The original mixture of plants fit the soil and climate of the range site so perfectly that other kinds of plants cannot move in unless an area is disturbed. So consistent is the relationship between plants, climate, and soils that the climax plant community can be accurately predicted, even on severely disturbed sites, if the soil is identified.

Range conservationists and soil scientists, working together, have grouped the soils which naturally grow the same climax plant communities into range sites.

Repeated overuse by grazing animals, excessive burning, and plowing cause changes in the kinds and proportions, or amounts, of climax plants in the plant community. Depending on the kind and degree of disturbance, some plants increase while others decrease. If the disturbance is severe, plants which do not belong in the climax plant community may invade. Plant response to grazing use depends on the kind of grazing animal, the season of use, and how closely the plant is grazed. If good management follows disturbances, however, the climax plant community is gradually reestablished on all but seriously eroded soils.

Range condition is an expression of how the present plant community compares with the climax plant community for the range site. The more nearly the present kinds and amounts of plants are like the climax plant mixture, the better the range condition.

Four range condition classes are used to indicate changes in the plant community brought about by grazing or other uses. These condition classes show the

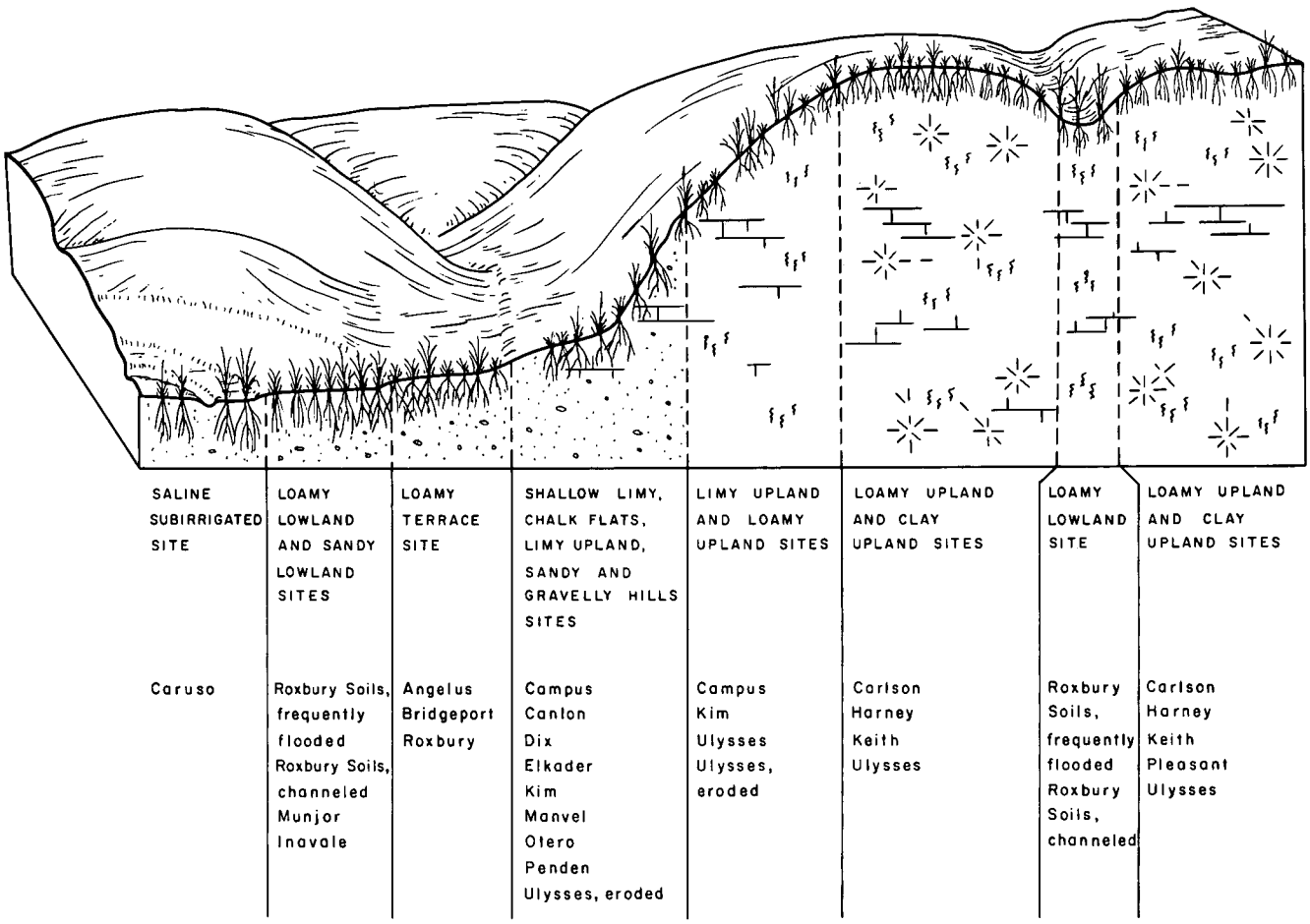


***Figure 14.*—This diagram shows the relative positions of the major range sites in Gove County.**

present condition of the native vegetation and provide an index to changes which have taken place in the plant community.

A range is in *excellent* condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand. It is in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if the percentage is less than 25. Thus, the range condition rating indicates the nature of the present plant community. The improvement of climax cover for the range sites represents a goal toward which range management may be directed.

Knowledge of the climax plant communities of range sites and the nature of present plant communities in relation to that potential is important in planning and

acre. It increases to 3,000 pounds per acre in favorable years and decreases to 1,500 pounds or less per acre in unfavorable years.

Selenium poisoning can be a problem on this range site *(8)*. In Gove County it is associated with soils formed from the Smoky Hill member of the Niobrara Formation. Range animals are most likely to be affected when the supply of good forage is limited and there is little opportunity for the grazing animal to make any selection of less toxic plants. No practical protective measures are available except to limit grazing in the affected areas. Desert princesplume is a plant which readily absorbs selenium from the soil and is used as an indicator of the presence of selenium.

LIMY UPLAND RANGE SITE

Sizable amounts of this range site are in the southern and eastern parts of the county. Some of the se- and decreases to 800 pounds or less per acre in unfavorable years.

acre. It increases to 4,000 pounds per acre in favorable years and decreases to 2,000 pounds or less per acre in unfavorable years.

LOAMY TERRACE RANGE SITE

Most of this range site is in the southern part of the county near the Smoky Hill River and along some of the larger tributaries. Water is received as runoff from adjacent uplands or from stream flooding. Generally the site is in fair to good condition, and increaser plants provide most of the grazing.

If this site is in excellent condition, it can support most of the mid grass and tall grass decreaser grasses, such as sideoats grama, tall dropseed, switchgrass, and slimflower scurfpea. The decreaser plants make up 60 [redacted]

Common increasers are inland saltgrass, sedges, western ragweed, blue grama, and buffalograss. The site is commonly invaded by alkali muhly, little barley, annual brome, and tamarisk.

If this site is in excellent condition, the average annual yield of air-dry herbage is 5,000 pounds per acre. Very little difference in yield will be noticed during dryer periods because of the subirrigated condition.

SANDY RANGE SITE

Only Otero fine sandy loam, undulating, is in this range site. It is in small areas bordering the larger streams and the Smoky Hill River. Generally it is in only fair condition under the present grazing use, and [redacted]

Figure 16.—**The Sandy Lowland range site in the background supplies good high-quality forage for livestock. A Chalk Flats range site is in the foreground.**

sirable decreaser plants. This site is less accessible to livestock than the Limy Upland site.

If this site is in excellent condition, it can support

for windbreaks, shade, or landscaping purposes. Most trees and shrubs are planted around farm or ranch headquarters, corrals, and feed yards to protect these

TABLE 3.—*Windbreaks and environmental plantings*

[Dashes mean that the species does not grow well on that soil. Only soils suited to trees are listed]

Soil series and map symbols	Expected heights of specified trees at 20 years of age								
	Ponderosa pine	Eastern redcedar	Honeylocust	Siberian elm	Osage-orange	Russian-olive	Hackberry	Eastern cottonwood	Green ash
	Ft	*Ft*	*Ft*	*Ft*	*Ft*	*Ft*	*Ft*	*Ft*	*Ft*
Angelus: An	20	24	24	35	20	20	20	45	----
Bridgeport: Br	25	25	28	45	30	22	35	55	35
Campus: Cc Canlon part is unsuited.	15	16	22	28	18	16	20	----	----
Carlson: Cd	24	24	24	33	18	18	20	----	----
Campus part of Cd	15	16	22	28	18	16	20	----	----
Caruso: Cr	25	28	----	42	28	20	32	50	----
Elkader: Eb, Ec, Ed	15	15	20	28	15	15	20	----	----
Manvel part of Ed	15	15	18	25	15	15	18	----	----
Harney: Ha, Hb	24	24	24	33	18	18	25	----	20
Inavale: In	25	23	25	40	25	20	30	50	28
Keith: Ka, Kb	21	17	23	32	20	20	30	----	20
Kim: Kp	18	18	25	25	15	20	25	----	----
Penden part of Kp	20	20	27	35	20	20	25	----	----
Manvel: Ma, Mb Badland part of Mb is unsuited.	15	15	18	25	15	15	18	----	----
Munjor: Mc, Md	25	25	28	45	35	20	35	50	30
Bridgeport part of Mc	25	25	28	45	35	22	35	55	35
Inavale part of Md	25	23	25	40	32	20	30	50	28

Figure 17.—**Drifted snow caught in a farmstead windbreak on Ulysses silt loam.**

prey, as well as meadowlarks, robins, mourning doves, cardinals, and other songbirds inhabit the county. Migrating waterfowl use farm ponds and the water ponded in upland depressions as resting places during their migration through Kansas.

Many farm ponds provide good to excellent fishing for bass, bluegill, channel catfish, and bullheads. The estimated annual fish production from farm ponds is 100 to 300 pounds per acre. All stocked fish should be harvested to maintain a balanced population; the annual yield should be kept in mind when fishing a pond. The Hackberry and Big Creeks in Gove County and Cedar Bluff Reservoir in adjoining Trego County offer additional fishing opportunities.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and soils also affect the development of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, inadequate, or inaccessible, [illegible] be created or improved by planting appropriate vegetation, by properly managing the existing plant cover, and by fostering the natural establishment of desirable plants.

In table 4 the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in—

1. Planning the use of parks, wildlife refuges, nature study areas, and other developments for wildlife.
2. Selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat.
3. Determining the intensity of management needed for each element of the habitat.
4. Determining suitable areas to acquire for wildlife management.

The potential of the soil for producing habitat is described as good, fair, [illegible] in table 4.

potentials

oor." Dashes indicate that the soil was not rated]

ents			Potential as habitat for—		
rubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
_____	Poor	Poor	Fair	Poor	Fair.
_____	Poor	Poor	Good	Poor	Fair.
_____	Very poor.	Very poor.	Fair	Very poor.	Fair.
_____	Very poor.	Very poor.	Poor	Very poor.	Fair.
_____	Poor	Fair	Fair	Poor	Poor.
_____	Very poor.	Very poor.	Fair	Very poor.	Fair.
_____	Fair	Fair	Fair	Fair	Fair.
_____	Very poor.	Very poor.	Very poor.	Very poor.	Poor.
_____	Poor	Fair	Fair	Poor	Poor.
_____	Poor	Poor	Fair	Poor	Poor.
_____	Very poor.	Very poor.	Fair	Very poor.	Poor.
_____	Poor	Very poor.	Poor	Very poor.	Fair.
_____	Poor	Good	Fair	Fair	Poor.
_____	Poor	Fair	Fair	Poor	Poor.
_____	Very poor.	Very poor.	Fair	----------	Very poor.
_____	Very poor.	Very poor.	Good	Very poor.	Good.
_____	Very poor.	Very poor.	Fair	Very poor.	Fair.
_____	Very poor.	Poor	Fair	Very poor.	Fair.
_____	Poor	Very poor.	Poor	----------	Fair.
_____	Very poor.	Very poor.	Very poor.	Very poor.	Poor.

r	Good		Good	Poor	Poor	Fair	Poor
d	Good		Fair	Poor	Poor	Good	Poor
r	Good	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.
r	Fair		Fair	Poor	Very poor.	Fair	Very poor.
d	Fair		Poor	Very poor.	Poor	Fair	Very poor.
r	Fair		Fair	Poor	Poor	Fair	Poor
d	Good		Fair	Poor	Fair	Good	Poor
r	Fair		Fair	Poor	Fair	Fair	Poor
r	Fair		Fair	Poor	Fair	Poor	Poor
d	Fair		Poor	Poor	Fair	Fair	Poor
d	Fair		Poor	Poor	Poor	Fair	Poor
r	Fair		Poor	Very poor.	Very poor.	Fair	Very poor.

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satisfactory results can be expected when the soil is used for the designated purpose.

Fair means that the element of wildlife habitat or kind of habitat can be created, improved, or main-

food or cover for wetland wildlife. Examples of wetland plants are smartweed, sedges, reeds, saltgrass, cordgrass, and cattail. Major soil properties affecting wetland plants are texture of the surface layer, wet-

ment and fairly frequent attention are required for satisfactory results.

Poor means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and requires intensive effort.

Very poor means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wild-

Shallow water areas are bodies of surface water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water control devices in marshes or streams. Examples are muskrat marshes, water fowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of

TABLE 5.—*Recreational development*

["Percs slowly" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. See the description of the mapping unit for the composition and behavior characteristics of the mapping unit]

Soil series and map symbols	Degree and kind of limitation for—			
	Camp areas	Picnic areas	Playgrounds	Paths and trails
Angelus: An	Severe: floods	Moderate: floods	Moderate: floods	Slight.
Bridgeport: Br	Severe: floods	Moderate: floods	Severe: floods	Slight.
*Campus: Cc:				
Campus part	Moderate: too clayey.	Moderate: too clayey.	Severe: slope	Moderate: too clayey.
Canlon part	Severe: slope	Severe: slope	Severe: depth to rock.	Moderate: slope.
*Carlson: Cd:				
Carlson part	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Campus part	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Caruso: Cr	Severe: floods	Moderate: floods, wetness.	Severe: floods	Slight.
*Dix: Dx	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
*Elkader:				
Eb, Ec	Slight	Slight	Moderate: slope	Slight.
Ed:				
Elkader part	Moderate: slope	Moderate: slope	Severe: slope	Slight.

TABLE 5.—*Recreational development*—Continued

Soil series and map symbols	Degree and kind of limitation for—			
	Camp areas	Picnic areas	Playgrounds	Paths and trails
Otero: Ot	Slight	Slight	Slight	Slight.
Penden: Pe	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Pleasant: Pt	Severe: floods	Moderate: floods.	Severe: floods	Moderate: too clayey.

Figure 18.—**Recreation wagon train in open prairie in the southeastern part of the county.**

quid limit, plasticity index, soil reaction, depth to and hardness of bedrock within 5 or 6 feet of the surface, soil wetness characteristics, depth to a seasonal water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

Based on the information assembled about soil properties, ranges of values may be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values may be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, commercial, industrial, and recreational areas.
2. Make preliminary estimates pertinent to construction in a particular area.
3. Evaluate alternate routes for roads, streets, highways, pipelines, and underground cables.
4. Evaluate alternate sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities.
5. Plan detailed onsite investigations of soils and geology.
6. Seek sources of gravel, sand, clay, and topsoil.
7. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation.
8. Relate performance of structures already built to the properties of the soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted.
9. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Building site development

The degree and kind of soil limitations that affect

shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and

streets are indicated in table 6. Soil limitations are expressed as slight, moderate, and severe. *Slight* means that soil properties are generally favorable for the given use, or, in other words, the limitations are minor and easily overcome. *Moderate* means that some soil properties and site features are unfavorable, but the limitations can be overcome or modified by special planning and design. *Severe* means that soil properties or site features are so unfavorable or limitations are so difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils that have severe limitations such costly measures may not be feasible.

Shallow excavations are used for pipelines, sewer lines, telephone and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by the soil wetness resulting from a seasonal high water table, by the texture and consistence of soils, by the tendency of soils to cave in or slough, and by the presence of very firm, dense soil layers, bedrock, or large stones (fig. 20). In addition,

probability of flooding. Ratings do not apply to soils [illegible] major soil reclamation, special de-

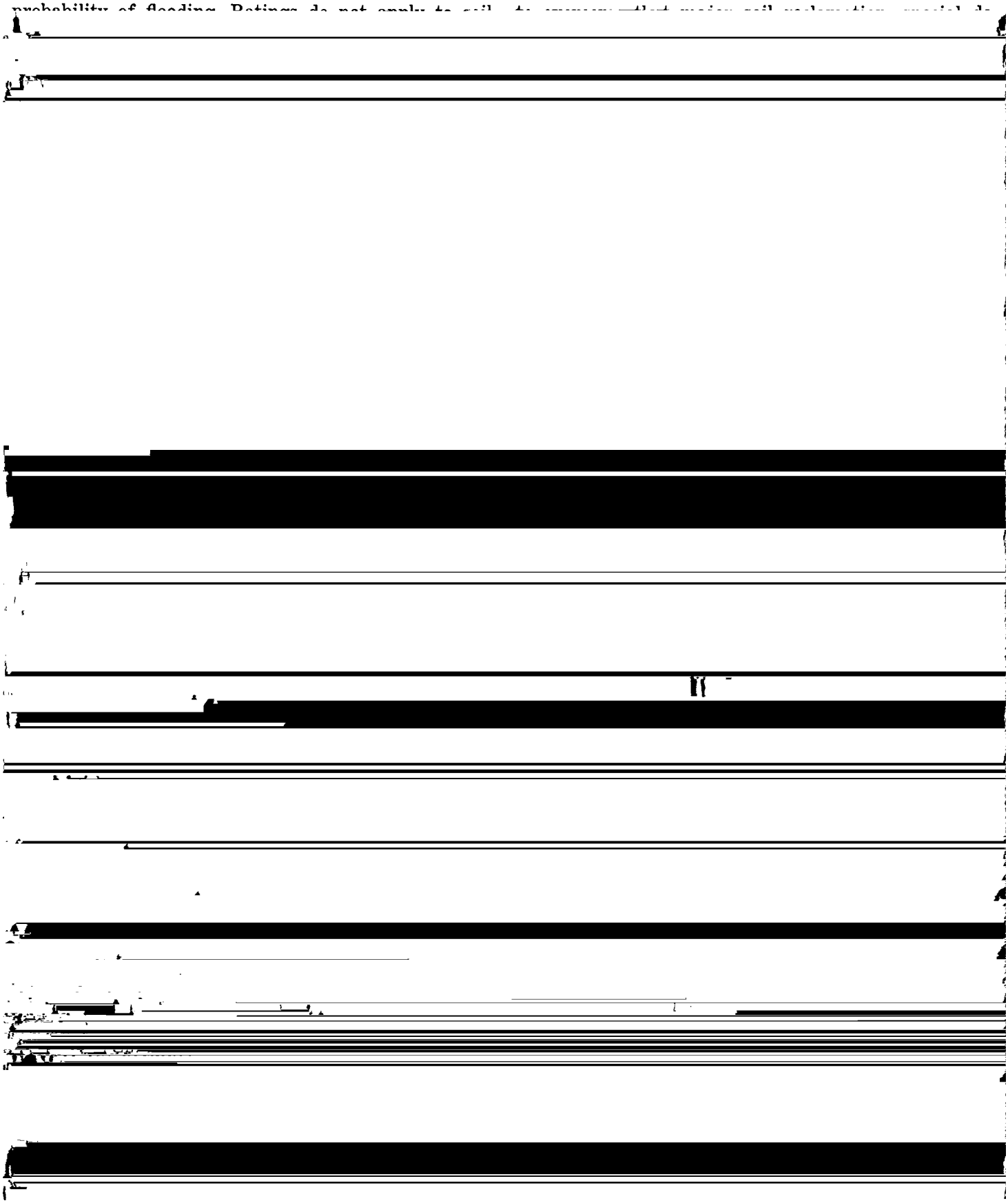


TABLE 6.—*Building site development*

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for

TABLE 6.—*Building site development*—Continued

Soil series and map symbols	Degree and kind of limitation for—				

TABLE 7.—*Sanitary facilities*

["Percs slowly" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. See the description of the mapping unit for the composition and behavior characteristics of the mapping unit]

Soil series and map symbols	Degree and kind of limitation for—				Suitability for daily cover for landfill
	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	
Angelus: An	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Good.

TABLE 7.—*Sanitary facilities*—Continued

Soil series and map symbols	Degree and kind of limitation for—				
	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Suitability for daily cover for landfill
Manvel—Con.					
Badland part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope	Poor: thin layer, slope.
[redacted]					

TABLE 8.—*Construction materials*

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. See description of the mapping unit for the composition and behavior characteristics of the mapping unit]

Soil series and map symbols	Suitability as a source of—			
	Road fill	Sand	Gravel	Topsoil
Angelus: An	Fair: low strength	Unsuited	Unsuited	Good.
Bridgeport: Br	Fair: low strength	Unsuited	Unsuited	Good.
*Campus: Cc (both parts)	Poor: thin layer	Unsuited	Unsuited	Poor: area reclaim.
*Carlson: Cd:				
Carlson part	Poor: low strength	Unsuited	Unsuited	Fair: too clayey.
Campus part	Poor: thin layer	Unsuited	Unsuited	Poor: area reclaim.
Caruso: Cr	Fair: low strength	Unsuited	Unsuited	Good.
*Dix: Dx	Fair: slope	Good	Good	Poor: small stones, area reclaim, slope.
*Elkader:				
Eb, Ec	Fair: low strength	Unsuited	Unsuited	Good.
Ed:				
Elkader part	Fair: low strength	Unsuited	Unsuited	Fair: slope.
Manvel part	Fair: low strength, shrink-swell.	Unsuited	Unsuited	Fair: excess lime, area reclaim, slope.
Harney: Ha, Hb	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: thin layer.
*Inavale: In	Good	Fair: excess fines	Unsuited	Poor: too sandy, area reclaim.
Keith: Ka, Kb	Fair: shrink-swell	Unsuited	Unsuited	Good.
*Kim: Kp:				
Kim part	Fair: low strength	Unsuited	Unsuited	Fair: slope.
Penden part	Poor: low strength	Unsuited	Unsuited	Fair: too clayey.
*Manvel:				
Ma	Fair: low strength	Unsuited	Unsuited	Fair: excess lime, area reclaim.
Mb:				
Manvel part	Fair: low strength	Unsuited	Unsuited	Fair: excess lime, area reclaim, slope.
Badland part	Poor: slope	Unsuited	Unsuited	Poor: thin layer, slope.
*Munjor: Mc, Md	Fair: low strength	Poor: excess fines	Unsuited	Good.

TABLE 8.—*Construction materials*—Continued

Soil series and map symbol	Suitability as a source of—			
	Road fill	Sand	Gravel	Topsoil
Penden: Pe	Poor: low strength	Unsuited	Unsuited	Fair: too clayey.
Pleasant: Pt	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey.
*Roxbury: Ra, Rb, Rx	Fair: low strength, shrink-swell.	Unsuited	Unsuited	Good.
Ulysses: Ua, Ub, Uc, Ud, Ue.	Fair: shrink-swell, low strength.	Unsuited	Unsuited	Good.

[redacted]

shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, texture, reaction, and other features significant in planning, installing, and maintaining water control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for this use have low seepage potential, which is determined by the permeability and depth over fractured or permeable bedrock or other permeable material.

TABLE 9.—*Water management*

["Seepage" and some of the other terms that describe restrictive soil features are defined in the Glossary. An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. See the description of the mapping unit for the composition and behavior characteristics for the mapping unit]

Soil series and map symbols	Soil properties and site features affecting—					
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Angelus: An	Seepage	Low strength, piping.	Not needed	Floods	Not needed	Favorable.
Bridgeport: Br	Seepage	Low strength, piping.	Floods	Floods	Not needed	Favorable.
*Campus: Cc:						
Campus part	Depth to rock	Thin layer, erodes easily.	Not needed	Erodes easily, droughty.	Depth to rock, erodes easily.	Depth to rock, erodes easily.
Canlon part	Depth to rock, slope.	Thin layer	Not needed	Slope, rooting depth, excess lime.	Depth to rock, slope.	Rooting depth, slope.
*Carlson: Cd:						
Carlson part	Favorable	Low strength	Favorable	Slow intake, slope.	Percs slowly	Percs slowly.
Campus part	Depth to rock	Thin layer,	Not needed	Erodes easily,	Depth to rock,	Depth to rock,

TABLE 9.—*Water management*—Continued

Soil series and map symbols	Soil properties and site features affecting—					
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
*Manvel: Ma	Slope, seepage.	Erodes easily, low strength, piping.	Slope	Excess lime, slope, erodes easily.	Erodes easily	Erodes easily.
Mb: Manvel part	Slope	Erodes easily	Slope	Excess lime	Erodes easily	Erodes easily.

icates that at
and behavior

id it	Plas- ticity index
40	5–15
40	8–15
40	8–15
45	7–20
45	11–20
45	11–20
40	7–20
40	5–20
55	15–30
45	5–25
45	7–20
45	11–20
45	11–20
40	5–20
45	5–20
----	NP[1]
----	NP
----	--------
45	5–20
45	5–20
50	5–15
40	7–20

silty	L, CL-ML	A–4, A–6	0		100	95–100	85–100	25–40	5–20
	, CH	A–6, A–7	0		100	95–100	85–100	37–60	15–35
am,		A–6	0		100	95–100	85–100	30–40	11–25
		A–2	0		100	85–95	15–35		NP
		A–2	0	100	90–100	65–85	15–30		NP
se	-SM, SM	A–2, A–3	0	100	90–100	65–85	5–30		NP
	L, CL	A–4	0		100	95–100	85–95	20–35	2–10
lty		A–6	0		100	95–100	85–100	30–40	11–20
	, CL	A–4	0		100	95–100	85–95	20–35	2–10
	, CL	A–4	0–5	80–100	75–100	60–90	45–75	20–35	NP–5
loam	, CL-ML	A–4, A–6	0–5	80–100	75–100	70–95	60–85	25–40	5–15
		A–6, A–7–6	0		100	85–100	65–95	30–45	11–25
		A–6, A–7–6	0		100	75–100	55–90	30–45	11–25
	-ML, CL	A–7–5, A–4, A–6	0	95–100	95–100	95–100	70–95	25–50	5–15
lty	, ML	A–6, A–4	0	95–100	95–100	95–100	80–95	30–40	7–20
	-ML, CL	A–7–5, A–4, A–6	0	95–100	95–100	95–100	70–95	25–50	5–15
lty	, ML	A–6, A–4	0	95–100	95–100	95–100	80–95	30–40	7–20
	, SC, ML, L	A–2–4, A–4	0	100	95–100	65–95	30–75	10–30	3–10
	, SC, ML, L	A–2–4, A–4	0	100	95–100	65–85	30–65	10–30	3–10
	, SP-SM, P	A–2–4	0	98–100	95–100	55–80	5–30		NP
	, SM	A–4	0		100	90–100	45–70	<25	NP–6
lty loam.	, CL	A–4, A–6	0		100	95–100	85–100	25–40	8–20
		A–2	0		100	85–95	15–35		NP
		A–2	0	100	90–100	65–85	15–30		NP
se	-SM, SM	A–2, A–3	0	100	90–100	65–85	5–30		NP
, fine n.		A–2, A–1	0	90–100	50–100	40–80	20–35		NP
d.		A–2	0	95–100	80–100	50–80	20–35		NP

TABLE 10.—*Engineering properties and classifications*—Continued

Soil series and map symbols	Depth	USDA texture	Classification		Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
Penden: Pe	0–10	Clay loam	CL	A–6, A–7–6	0		100	85–100	65–95	30–45	11–25
	10–60	Clay loam	CL	A–6, A–7–6	0		100	75–100	55–90	30–45	11–25
Pleasant: Pt	0–6	Silty clay loam	CL	A–6	0		100	95–100	85–100	20–40	15–30
	6–30	Silty clay, clay	CH, CL	A–7–6	0		100	95–100	85–100	40–75	25–45
	30–60	Silty clay loam	CL	A–6	0		100	95–100	85–100	20–40	15–35
*Roxbury: Ra, Rb, Rx	0–24	Silt loam	ML, CL	A–4, A–6, A–7–6	0		100	96–100	65–98	30–45	7–20
	24–60	Silt loam, silty clay loam.	ML, CL	A–4, A–6, A–7–6	0		100	96–100	80–98	30–45	7–25
Ulysses: Ua, Ub, Uc, Ud, Ue.	0–10	Silt loam	ML, CL	A–4, A–6	0		100	90–100	85–100	25–40	7–15
	10–60	Silt loam, silty clay loam.	CL	A–6	0		100	90–100	85–100	25–40	11–20

[1] NP means nonplastic.

Most soils have, within the upper 5 or 6 feet, hori- in diameter that passes each of four standard sieves is

TABLE 11.—*Physical and chemical properties of soils*

[Dashes indicate data were not available. The symbol < means less than; > means greater than. The erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not estimated. An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. See the description of the mapping unit for the composition and behavior characteristics of the mapping unit]

Soil series and map symbols	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
							Uncoated steel	Concrete	K	T	
	In	*In per hr*	*In per in*	*pH*	*Mmhos per cm*						
Angelus: An	0–60	0.6–2.0	0.18–0.22	7.9–8.4	<2	Low	Low	Low			4L
Bridgeport: Br	0–13	0.6–2.0	0.20–0.24	7.4–8.4	<2	Low	Low	Low	0.32	5	4L
	13–60	0.6–2.0	0.17–0.22	7.9–8.4	<2	Low	Low	Low	0.43		
*Campus: Cc:											
Campus part	0–5	0.6–2.0	0.17–0.22	7.9–8.4	<2	Low	Low	Low	0.28	4	4L
	5–20	0.6–2.0	0.17–0.19	7.9–8.4	<2	Low	Low	Low	0.28		
	20–30	0.6–2.0	0.15–0.19	7.9–8.4	<2	Low	Low	Low	0.28		
	30										
Canlon part	0–15	0.6–2.0	0.12–0.16	7.9–8.4	<2	Low	Low	Low	0.32	2	4L
	15										
*Carlson: Cd:											
Carlson part	0–10	0.6–2.0	0.19–0.24	7.4–7.8	<2	Low	Moderate	Low	0.32	5	6
	10–19	0.2–0.6	0.14–0.19	7.4–8.4	<2	Moderate	High	Low	0.43		
	19–60	0.6–2.0	0.16–0.20	7.4–8.4	<2	Low	Moderate	Low	0.43		
Campus part	0–5	0.6–2.0	0.17–0.22	7.9–8.4	<2	Low	Low	Low	0.28	4	4L
	5–20	0.6–2.0	0.17–0.19	7.9–8.4	<2	Low	Low	Low	0.28		
	20–30	0.6–2.0	0.15–0.19	7.9–8.4	<2	Low	Low	Low	0.28		
	30										
Caruso: Cr	0–19	0.6–2.0	0.19–0.23	7.4–8.4	<2	Low	High	Moderate			4L
	19–60	0.2–2.0	0.16–0.22	7.9–8.4	<2	Low	High	Moderate			
*Dix: Dx	0–6	6.0–20	0.16–0.18	7.4–8.0	<2	Low	Low	Low	0.15	2	5
	6–16	6.0–20	0.02–0.04	7.4–8.4	<2	Low	Low	Low	0.15		
	16–60	>20	0.02–0.04	7.9–8.4	<2	Low	Low	Low	0.15		
*Elkader:											
Eb Ec	0–60	0.6–2.0	0.18–0.22	7.9–8.4	<2	Low	Low	Low	0.32	5	4L
Ed:											
Elkader part	0–60	0.6–2.0	0.18–0.22	7.9–8.4	<2	Low	Low	Low	0.32	5	4L
Manvel part	0–3	0.6–2.0	0.18–0.20	7.9–8.4	<2	Low	Moderate	Moderate	0.37	5	4L
	3–60	0.2–2.0	0.16–0.18	7.9–8.4	2–4	Low	High	Moderate	0.43		
Harney: Ha, Hb	0–10	0.6–2.0	0.21–0.24	6.1–7.3	<2	Low	Moderate	Low	0.32	5–4	6
	10–28	0.2–0.6	0.12–0.19	6.6–8.4	<2	High	High	Low	0.43		
	28–60	0.6–2.0	0.18–0.22	7.9–8.4	<2	Low	Moderate	Low	0.43		
*Inavale: In	0–7	>6.0	0.07–0.12	7.4–8.4	<2	Low	High	Low	0.17	5	2
	7–18	6.0–20	0.09–0.11	7.9–8.4	<2	Low	High	Low	0.17		
	18–60	6.0–20	0.05–0.07	7.9–8.4	<2	Low	High	Low	0.17		

:b	0–12	0.6–2.0	0.22–0.24	6.6–7.8	<2	Low	Low	Low	0.32	5	6
	12–22	0.6–2.0	0.20–0.22	7.4–8.4	<2	Moderate	Low	Low	0.43		
	22–60	0.6–2.0	0.19–0.21	7.9–8.4	<2	Low	Low	Low	0.43		
:	0–5	0.6–2.0	0.16–0.18	7.9–8.4	<2	Low	Moderate	Low	0.32	5	4L
	5–60	0.6–2.0	0.15–0.17	7.9–8.4	<2	Low	Moderate	Low	0.32		
art	0–10	0.2–2.0	0.17–0.22	7.4–8.4	<2	Moderate	Moderate	Low	0.28	5–4	4L
	10–60	0.2–2.0	0.15–0.19	7.9–8.4	<2	Moderate	Moderate	Low	0.37		
	0–3	0.6–2.0	0.18–0.20	7.9–8.4	<2	Low	Moderate	Moderate	0.37	5	4L
	3–60	0.2–2.0	0.16–0.18	7.9–8.4	2–4	Low	High	Moderate	0.43		
art	0–3	0.6–2.0	0.18–0.20	7.9–8.4	<2	Low	Moderate	Moderate	0.37	5	4L
	3–60	0.2–2.0	0.16–0.18	7.9–8.4	2–4	Low	High	Moderate	0.43		
part. (Too variable stimated.)											
Md	0–11	2.0–6.0	0.14–0.20	7.9–8.4	<2	Low	Low	Low			
	11–36	2.0–6.0	0.13–0.18	7.9–8.4	<2	Low	Low	Low			4L
	36–60	6.0–20	0.06–0.09	7.9–8.4	<2	Low	Low	Low			
t part of Mc	0–13	0.6–2.0	0.20–0.24	7.4–8.4	<2	Low	Low	Low	0.32	5	4L
	13–60	0.6–2.0	0.17–0.22	7.9–8.4	<2	Low	Low	Low	0.43		
art of Md	0–7	>6.0	0.07–0.12	6.6–8.4	<2	Low	High	Low	0.17	5	2
	7–18	6.0–20	0.09–0.11	6.6–8.4	<2	Low	High	Low	0.17		
	18–60	6.0–20	0.05–0.07	6.6–8.4	<2	Low	High	Low	0.17		
	0–30	6.0–20	0.08–0.12	7.9–8.4	<4	Low	High	Low	0.10	5	4L
	30–60	6.0–20	0.09–0.11	7.9–8.4	<4	Low	High	Low	0.10		
	0–10	0.2–2.0	0.17–0.22	7.4–8.4	<2	Moderate	Moderate	Low	0.28	5–4	4L
	10–60	0.2–2.0	0.15–0.19	7.9–8.4	<2	Moderate	Moderate	Low	0.37		
	0–6	0.6–2.0	0.17–0.21	6.1–7.3	<2	Moderate	High	Low	0.43	4	7
	6–30	<0.06	0.12–0.18	6.1–7.3	<2	High	High	Low	0.43		
	30–60	0.2–2.0	0.16–0.21	7.4–8.4	<2	Moderate	High	Low	0.43		
, Rb, Rx	0–24	0.6–2.0	0.22–0.24	6.6–8.4	<2	Moderate	Low	Low	0.32	5	4L
	24–60	0.6–2.0	0.17–0.22	7.9–8.4	<2	Moderate	Low	Low	0.43		
Ub, Uc, Ud, Ue	0–10	0.6–2.0	0.20–0.24	6.6–8.4	<2	Moderate	Low	Low	0.32	5–4	6
	10–60	0.6–2.0	0.18–0.22	7.9–8.4	<2	Moderate	Low	Low	0.43		

TABLE 12.—*Soil and water features*

[Dashes indicate that the feature is not a concern. See text for descriptions of hydrologic groups. See "flooding" and "water table" in the Glossary for definitions of such terms as "rare," "brief," and "apparent." The symbol < means less than; > means greater than. An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. See the description of the mapping unit for the composition and behavior characteristics of the mapping unit]

Soil series and map symbols	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	
Angelus: An	B	Occasional	Very brief	Apr. to Sept.	>6.0			>60		Moderate.
Bridgeport: Br	B	Occasional	Very brief	Apr. to Sept.	>6.0			>60		Moderate.
*Campus: Cc:										
Campus part	B	None			>6.0			20–40	Rippable	Low.
Canlon part	D	None			>6.0			10–20	Hard	
*Carlson: Cd:										
Carlson part	C	None			>6.0			>60		Low.
Campus part	B	None			>6.0			20–40	Rippable	Low.
Caruso: Cr	C	Occasional	Very brief	Apr. to Sept.	2.0–6.0	Apparent	Mar.-June	>60		Moderate.
*Dix: Dx	A	None			>6.0			>60		Low.
*Elkader:										
Eb Ec	B	None			>6.0			>40	Rippable	Moderate.
Ed:										
Elkader part	B	None			>6.0			>40	Rippable	Moderate.
Manvel part	C	None			>6.0			>40	Rippable	Low.
Harney: Ha, Hb	C	None			>6.0			>60		Low.
*Inavale: In	A	Frequent	Very brief	Apr. to Sept.	>6.0			>60		Low.
Keith: Ka, Kb	B	None			>6.0			>60		Moderate.
*Kim: Kp (both parts)	B	None			>6.0			>60		Low.
*Manvel:										
Ma	C	None			>6.0			>40	Rippable	Low.
Mb:										
Manvel part	C	None			>6.0			>40	Rippable	Low.
Badland part	D	None			>6.0			0–10	Rippable	Low.
*Munjor: Mc, Md	B	Occasional	Very brief	Apr. to Sept.	>6.0			>60		
Bridgeport part of Mc	B	Occasional	Very brief	Apr. to Sept.	>6.0			>60		Moderate.
Inavale part of Md	A	Occasional	Very brief	Apr. to Sept.	>6.0			>60		Low.

Otero: Ot	B	None			>6.0			>60		Low.
Penden: Pe	B	None			>6.0			>60		Low.
Pleasant: Pt	D	Frequent	Brief to long	Mar. to Dec.	>6.0			>60		Low.
*Roxbury: Ra, Rb, Rx	B	Rare to frequent.	Very brief	Apr. to Sept.	>6.0			>60		Low.
Ulysses: Ua, Ub, Uc, Ud Ue.	B	None			>6.0			>60		Low.

TABLE 13.—*Engineering*

[Tests performed by the State Highway Commission of Kansas according to standard procedures of the American

Soil name and location	Parent material	Depth	Report	Moisture-density [1]	
				Maximum dry density	Optimum moisture
		Inches	*S73 Kansas number*	*Lb per cubic ft*	*Pct*
Elkader silt loam: about 13 miles south and 2 miles east of Gove, 792 feet west, 264 feet north of the southeast corner of section 8, T. 15 S., R. 28 W. (Modal)	Material weathered from Niobrara Chalk.	0–9	32–6–1	89	24
		9–20	32–6–2	99	21
		20–36	32–6–3	102	17
		36–60	32–6–4	102	19
Manvel silt loam: about 12 miles west and 9 miles south of Gove, 150 feet south and 2,300 feet west of the northeast corner of section 33, T. 14 S., R. 31 W. (Modal)	Material weathered from Niobrara Chalk.	0–3	32–5–1	82	26
		3–23	32–5–2	92	25
		23–60	32–5–3	94	23

[1] Based on AASHTO designation T99–61, method A, with the following variations: (1) all material is ovendried at 230° F; (2) all material is crushed in a laboratory crusher after drying; and (3) no time is allowed for dispersion of moisture after mixing with the soil material.

[2] Mechanical analyses according to the AASHTO designation T88–57 with the following variations: all material is ovendried at 230° F and crushed in a laboratory crusher; the sample is not soaked prior to dispersion; sodium silicate is used as the dispersing agent, and dispersing time, in minutes, is established by dividing the plasticity index value by 2; the maximum time is 15 minutes, and the minimum time is 1 minute. Results by this procedure frequently may differ somewhat from results that would

made for many soils. For others it was estimated on the basis of the kind of clay and on measurements of similar soils. Size of imposed loadings and the magnitude of changes in soil moisture content are also important factors that influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A *high* shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion, as used in table 11, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rating of soils for corrosivity to concrete is based mainly on the sulfate content, soil texture, and acidity. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely within one kind of soil or within one soil horizon.

Erosion factors are used in an equation that predicts the amount of erosion resulting from certain land treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to detachment and transport by rainfall. Soils having the highest numbers are the most erodible. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or wind, that may occur without causing reduced levels of crop production or environmental quality.

Wind erodibility groups are used to predict the susceptibility of soils to soil blowing and to predict the amount of soil blowing. The soils are grouped on the basis of similar properties that affect soil blowing, principally those that determine the ability of aggregates to resist breakdown by tillage and abrasion by wind. These properties include texture, organic matter, the content of calcium carbonate, soil moisture, mineralogy, susceptibility to frost action, and others. Soils that are most subject to blowing are in group 1, soils progressively less subject to blowing are in groups 2 through 7, and soils that are generally not subject to blowing are in group 8. A brief description of each group follows.

1.—Very fine, fine, and medium sands; dune sands.
2.—Loamy sands; loamy fine sands.
3.—Very fine sandy loams; fine sandy loams; sandy loams.
4.—Clays; silty clays; noncalcareous clay loams and silty clay loams that contain more than 35 percent clay.
4L.—Calcareous loams and silt loams; calcareous clay loams and silty clay loams that contain less than 35 percent clay.
5.—Noncalcareous loams and silty loams that contain less than 20 percent clay; sandy clay loams; sandy clay.
6.—Noncalcareous loams and silt loams that con-

test data

Association of State Highway and Transportation Officials (AASHTO) except as stated in footnotes 1 and 2]

Mechanical analysis [2]							Liquid limit	Plasticity index	Classification	
Percentage passing sieve—			Percentage smaller than—							
No. 10 (4.7 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO [3]	Unified
							Pct			
100	99	95	81	52	27	14	44	16	A–7–6(11)	CL–ML
100	98	80	85	69	44	28	40	18	A–6(11)	CL
100	99	92	88	76	55	41	36	16	A–6(10)	CL
100	100	98	95	87	66	44	38	15	A–6(10)	CL–ML
100	97	91	84	53	28	17	48	14	A–7–5(11)	ML
100	99	93	89	80	66	49	40	13	A–6(9)	CL–ML
100	98	85	80	66	38	18	35	7	A–4(8)	ML

have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette

value in land use planning and provides a valid basis for land use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

A *seasonal high water table* is the highest level of a saturated zone more than 6 inches thick in soils for continuous periods of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors, or mottles, in the soil and the depth to free water observed during the course of the soil survey. Indicated are the depth to the seasonal high water table; the kind of water table, whether perched, artesian, or the upper part of the ground water table; and the months of the year that the high water commonly is present. Only those saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not to construct basements and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

[redacted]

compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plasticity index measure the effect of water on the consistence of soil material as has been explained for table 10.

Formation and Classification of Soils

This section explains how soils form and discusses the factors that affected the formation of soils in Gove County. It describes briefly the current system of soil classification and places the soil series represented in the county in some classes of that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by the physical and mineralogical compo-

[redacted]

than 50 percent silt and less than 15 percent fine sand or coarser sand.

The Kim, Penden, Campus, and Canlon soils formed in plains outwash. These are loamy soils that are more than 15 percent fine sand or coarser sand.

The Elkador and Manvel soils formed in material de-

number of fine roots. Decomposed organic matter darkens the upper part of the soil and influences the development of soil structure. Plant growth and the accumulation of organic matter are greatest in the nearly level areas. As a result the nearly level Keith and Harney soils are darkened by organic matter to a

use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engin-

that tend to give broad climatic groupings of soils. Three exceptions to this are the Entisols, Histosols, and Vertisols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Moll-i-sol).

SUBORDER. Each order is divided into suborders

in broad classes in table 14 to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in

seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either

mation about climate, water supply, farming, and transportation. The statistics on agriculture and population are from the Census of Agriculture and Biennial Reports of the Kansas State Board of Agriculture.

History and Development

Gove County, named after Captain Grenville L. Gove, was settled in the late 1870's and [illegible]

land mass in middle latitudes. Such climates are characterized by large diurnal and annual variations in temperature. This variation is common in all of Kansas and in much of the area between the Rockies to the west and the Appalachian Mountains to the east.

The climate of Gove County has been classified by Thornthwaite (*6*) as semiarid. Precipitation and soil moisture in such a climate are generally insufficient

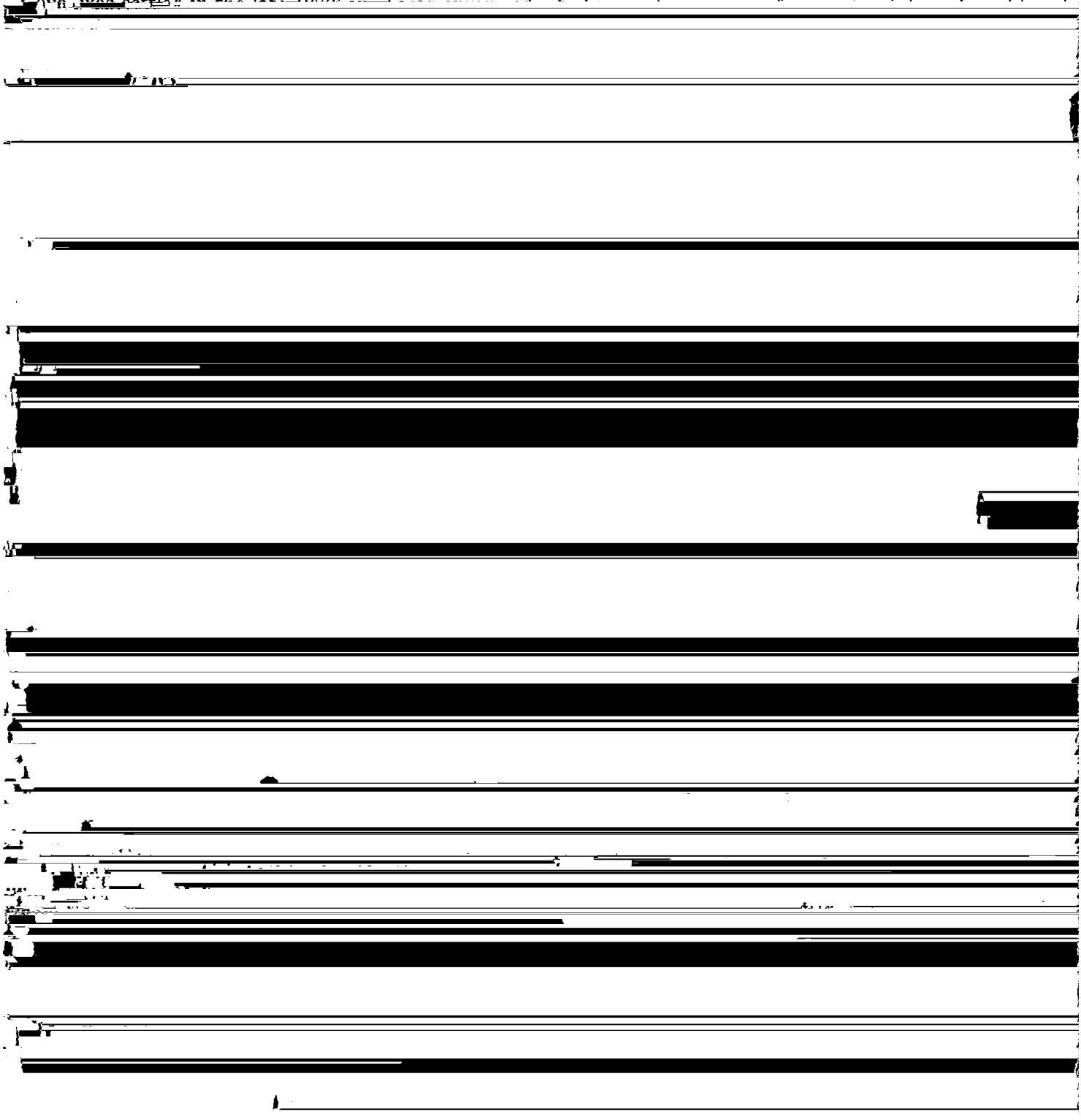


TABLE 15.—*Temperature and precipitation data*

[Data recorded at Quinter for the period 1941-70]

Month	Temperature				Precipitation		
	Average daily maximum	Average daily minimum	Two years in 10 will have about 4 days with [1]—		Average	One year in 10 will have—	
			Maximum temperature equal to or more than—	Minimum temperature equal to or less than—		Less than—	More than—
	°F	°F	°F	°F	*Inches*	*Inches*	*Inches*
January	41.0	14.0	62	−6	0.56	0.01	1.34
February	45.0	18.2	66	2	.68	.10	1.79
March	50.7	23.4	76	5	1.63	.19	3.20
April	64.6	36.8	83	25	2.04	.62	3.95
May	74.1	47.8	91	35	3.31	1.15	6.75
June	84.0	57.9	99	48	4.47	.84	8.34
July	90.7	63.8	103	56	3.49	1.02	7.20
August	90.0	62.4	102	53	2.98	.77	6.78
September	80.7	51.9	97	39	1.90	.20	3.56
October	70.2	39.7	88	27	1.49	.17	4.67
November	54.0	25.6	72	11	.64	(2)	2.12
December	43.5	17.5	64	2	.57	(2)	1.27
Year	65.8	38.4	106 [3]	−10 [4]	23.75	14.54	32.37

[1] For the period 1939–68.
[2] Trace of precipitation.
[3] Average annual highest temperature 1941–70.
[4] Average annual lowest temperature 1941–70.

Temperature ranges widely in a continental climate. moderately strong in all seasons, reach a maximum

TABLE 16.—*Probabilities of first and last freezing temperatures*

[Data recorded at Quinter]

Probability	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	April 7	April 15	April 22	April 30	May 18
2 years in 10 later than	April 1	April 9	April 17	April 25	May 13
5 years in 10 later than	March 20	March 30	April 8	April 15	May 3
Fall:					
1 year in 10 earlier than	October 30	October 26	October 17	October 11	September 29
2 years in 10 earlier than	November 4	October 31	October 21	October 16	October 2
5 years in 10 earlier than	November 16	November 10	October 31	October 25	October 12

Water Supply

In the northern one-fourth to one-third of Gove County, wells for domestic use can generally be drilled

According to the biennial report of the Kansas State Board of Agriculture, crops harvested in 1971 were wheat from 104,000 acres, sorghums for grain and seed

(9) United States Department of Agriculture, Soil Conservation Service. 1975. Soil taxonomy: a basic system of soil classification for making and interpreting soil surveys. U.S. Dep. Agric. Handb. 436. 754 pp., illus.

Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated

processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water

building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slick spot. Locally, a small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slow intake. The slow movement of water into the soil.

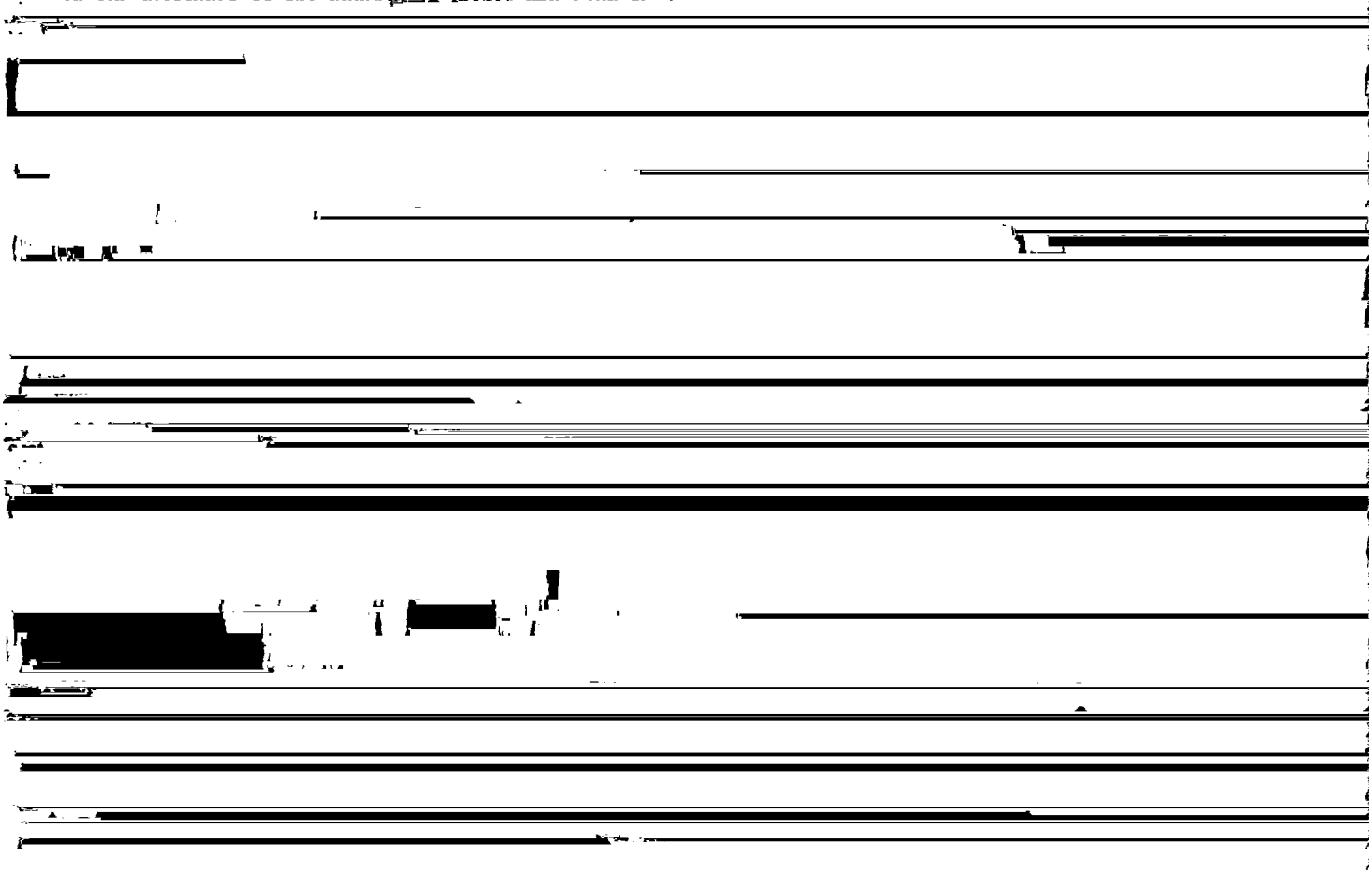
Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans.



GUIDE TO MAPPING UNITS

For a complete description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs. Range sites are described beginning on page 32.

Map symbol	Mapping unit	Page	Capability unit Dryland Symbol	Capability unit Irrigated Symbol	Range site Name
An	Angelus silt loam	9	IVw-3	IIIw-2	Loamy Terrace
Br	Bridgeport silt loam	10	IIc-2	I-2	Loamy Terrace
Cc	Campus-Canlon complex, 3 to 40 percent slopes	11	VIIe-1	-------	----------
	Campus part	--	-------	-------	Limy Upland
	Canlon part	--	-------	-------	Shallow Limy
Cd	Carlson-Campus complex, 1 to 3 percent slopes	12	IIIe-1	-------	----------
	Carlson part	--	-------	-------	Loamy Upland
	Campus part	--	-------	-------	Limy Upland
Cr	Caruso loam	12	IIIw-1	IIIw-1	Saline Subirrigated
Dx	Dix soils, 6 to 40 percent slopes	13	VIIs-1	-------	Gravelly Hills
Eb	Elkader silt loam, 1 to 3 percent slopes	14	IIIe-1	IIe-1	Limy Upland
Ec	Elkader silt loam, 3 to 6 percent slopes	14	IVe-1	-------	Limy Upland
Ed	Elkader and Manvel silt loams, 6 to 15 percent slopes	14	VIe-1	-------	----------
	Elkader part	--	-------	-------	Limy Upland
	Manvel part	--	-------	-------	Chalk Flats
Ha	Harney silt loam, 0 to 1 percent slopes	15	IIc-1	I-3	Loamy Upland
Hb	Harney silt loam, 1 to 3 percent slopes	15	IIe-1	IIe-2	Loamy Upland
In	Inavale soils	16	VIe-2	-------	Sandy Lowland
Ke	Keith silt loam, 0 to 3 percent slopes	17	IIc-1	I-1	Loamy Upland

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